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AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

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AGARD ADVISORY REPORT No.297

Report of AGARD Working Group No.13 on

Echocardiography in NATO Aircrew

(L'Echographie du Coeur)

NORTH ATLANTIC TREATY ORGANIZATION

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

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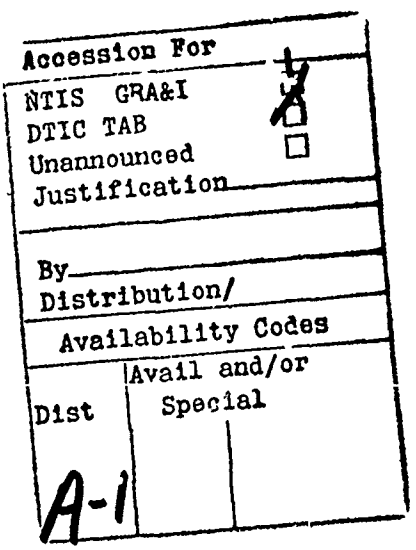

This Advisory Report was prepared at the request of the Aerospace Medical Panel of AGARD.

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- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community;
- Providing scientific and technical advice and assistance to the Military Committee in the field of aerospace research and development (with particular regard to its military application);
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture,
- Improving the co-operation among member nations in aerospace research and development;
- Exchange of scientific and technical information;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential,
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field.

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Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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Foreword

Cardiac echocardiography, with the addition of Doppler technology, is a valuable tool in clinical and research aerospace medicine. Cardiac echocardiography is a superb tool for resting structure and function, with increasing applications in the future for exercise echocardiography. As cardiac ultrasound is increasingly applied in aircrew screening, aircrew selection, surveillance, and aerospace research, the need has arisen for a common reporting format for the NATO air forces, so that studies may be reported in common terminology and comparable variables. Further, any collaborative studies undertaken by the NATO airforces will require a protocol and agreement upon which variables will be measured, where they will be measured, and how they will be reported. It will also be impossible to perform collaborative studies unless meticulous attention is paid to echocardiographic quality control.

The preliminary report of an apparent over-representation of right ventricular enlargement in Mirage 2000 pilots, when compared to a matched cohort of nonhigh-performance pilots in the French Air Force, underlined the need to see whether differences in echo parameters between these two populations could be sustained for this variable in a large multinational study. These preliminary studies, discussed elsewhere in this document, have focused our attention on the need to identify variables or groups of variables which may be of the greatest value in echocardiographic surveillance of aircrew members.

The purpose of the NATO Echocardiographic Working Group 13 was twofold:

1. To devise a reporting format for cardiac echocardiographic studies in aircrew
2. To write a protocol for a multinational echo study, addressing all of the issues in experimental design of both retrospective and prospective echocardiographic studies.

This AGARD publication consists of a statement of the experimental protocol. Very special attention should be paid to the Procedures Section (how to perform the protocol) and to the Technical Section (how to perform, record, measure, and report the individual echocardiograms). Central to both the Procedures and Technical Sections is the AGARD Echocardiography Worksheet. This Worksheet contains all of the pertinent demographic questions, subject identification data, matching variables for controls and subjects, as well as all M-mode, 2-D and Doppler values. The very last item of the Worksheet, Item #91, preserves the opportunity to add special subject identifiers in the future, such as the use of specific life-support systems, specific kinds of gravitational exposure, or other variables deemed important in the future. An extensive computer operations section is also included regarding software installation, data presentation ("windowing"), basic functions, options, appendices, validity limits for variables, card structure, and a glossary of technical terms. WG 13 is especially indebted to our computer engineer, Mr Bertrand Piedecoq, of C.E.R.M.A. (Paris), who wrote the computer programs for the AGARD Echocardiographic Worksheet. Mr Piedecoq rendered invaluable assistance to the working group in translating the decisions of the group into a computer format. The "Pilots" echocardiographic data acquisition software was designed to collect echo data and store the data on hard disks. Software to the NATO echocardiographic laboratories will be delivered in the form of 5¼ inch or 3½ inch floppy disks in the IBM PC format. The disks delivered to each participating laboratory will enable entry in three languages: French, English, or Spanish. The floppy disks will be transferred to a central data base (SAS software) for archiving and statistical analyses at Brooks AFB, Texas.

The Null Hypothesis, which is described in this document, can be adequately answered with 500 matched pairs (N = 1,000). Obviously, a far larger number of subjects will be required to gain 500 matched pairs. For the parameters under consideration, at a significant different of 10%, the WG wishes to assure that we will have a 95% minimum chance (for any single variable) of detecting a difference if one actually exists. For some of the variables, we will have a 99% minimum chance of detecting a difference if one actually exists. This sample size also guarantees that we will have no more than a 5% probability of declaring, for any variable, a difference when no difference actually exists. We cannot precisely know the sample size in advance, because the spread of echocardiographic data in healthy NATO aircrew has never been compiled. It may be that NATO echocardiographic data have less spread, and are more homogeneous. Thus, the standard deviations for NATO echocardiographic data may be smaller than those published in clinical references. We thus need to establish our own NATO echocardiographic norms. At a preliminary sample size of 250 subjects, and again at 500 subjects, required sample size will be recalculated. If the NATO aircrew data are more homogeneous, as expected, such a finding should dictate a reduction in the needed sample size.

A decision regarding the necessity of a longitudinal study of flying trainees will actually be made when the cross-sectional study is completed. In a longitudinal study, each subject would function as his own control. A longitudinal study will require color-coded Doppler information, information which was not always available in retrospective echocardiographic studies. The standard deviations for the values of Doppler data for left-sided cardiac structures are so large that a multinational study will be the only feasible approach to address aeromedical issues involving echocardiography. The population size necessary to detect small, but occupationally significant changes, is probably barely obtainable in a multinational sense. To detect acquired regurgitant lesions, changes in velocity, or changes in ejection times in high-performance aircrew will require a very substantial sample size if we are to detect small changes. The alternative, with smaller sample sizes, is to be satisfied with detecting only grosser changes. The pursuit of these occupational medicine issues gives us in NATO an opportunity to exploit one of our most valuable medical resources, our enormous potential reserve of pooled biomedical information.

Quality control has been one of the major issues for the Echocardiographic Working Group. It is quite simple to do a multi-center study if one simply reports data on a floppy disk and collates the data centrally. It is quite different to make sure that the studies were actually performed as the protocol requires, that all measurements were made on the same spatial ground rules, and that the studies were all of acceptable technical quality. The issues of quality control and the major determinants of sample size are inextricably related. Sample size is determined by the definition of what you perceive to be an acceptable significant difference between the two groups for any variable, the "spread" of normative data, within-in subject variability, interobserver variability, intraobserver variability, and your definition of matched pairs. Rigid qualitiy control is a prerequisite for the variability studies. Thus, the three types of variability are intextricably related to sample size, which is ultimately related to quality control. One can only perform variability determinations on studies of pristine quality, whose analyses are blinded, and whose quality is assured by random surveillance. The determination of variability is central to the issue of significant differences. One must abandon any hope of detecting differences which are equal to or smaller than the total of the three common types of variability in scientific studies. In essence, the work has only started when data collection begins. Many low statistical power studies are, in reality, reporting statistical accidents of procedure and subject variation.

The Working Group 13 members were as follows:

Air Comm. David Hull, United Kingdom
Col. Paul Vandenbosch, Belgium (Chairman)
Col. James R.Hickman, Jr, United States (Vice Chairman)
Dr Gary Gray, Canada
Col. Pierre Quandieu, France
Col. Henri Ille, France
Lt Col. Vicente Navarro, Spain
Lt Col. William Kruyer, United States
Maj. Ricky D.Latham, United States.

Other WG 13 observers and contributors were as follows:

Maj. Michael Blick, M.D., USAFSAM Cardiologist (United States)
Bertrand Piedecoq, Computer Engineer (France)
Ms Nancy Hopper, USAFSAM, Chief Echo Technician (United States)
Lt Marie-France LaLiberté, Aerospace Physiologist (Canada)
Mr Billy Jackson, USAFSAM Statistician (United States)
Mr William Nixon, Chief, Data Support Branch, USAFSAM (United States)
Mr William Besich, USAFSAM Computer Program Analyst (United States).

The division of labor among the participating countries was as follows:

Echocardiographic Software — France
Technical Section — United Kingdom and France
Procedures Section — Canada
Echo Data Worksheet — Canada and France
Protocol Section — United States
Quality Control — United States and Canada
Statistics — United States and France
Technical Translation — Spain and United Kingdom
Central Data Base — United States

The products submitted to the Aerospace Medical Panel of AGARD at the two-year conclusion of WG 13 were as follows:

1. Echocardiographic Data Worksheet
2. Echocardiographic software
3. Software Documentation Manual
4. Technical Section
5. Procedures Section
6. Experimental Protocol

All products except the extensive software documentation are included in this AGARD publication.

WG 13 members are grateful to the Aerospace Medical Panel for sponsorship of the Working Group. The WG extends a special thanks to the NATO countries which hosted meetings of the Working Group. Ms Margie Lee of USAI SAM, NG rendered invaluable editorial and transcription services in the completion of this document.

Avant-Propos

L'échographie du coeur, associée à la technologie Doppler, est un outil appréciable en médecine clinique et en médecine de recherche aérospatiale. C'est un outil remarquable de contrôle de la structure et des fonctions du coeur au repos, avec de plus en plus d'applications dans l'avenir en matière d'échographie du coeur à l'effort. Puisque, de plus en plus, les ultra-sons sont employés pour examiner le coeur lorsqu'il s'agit d'éliminir, de sélectionner le personnel navigant, de sa surveillance ou de recherche aérospatiale, le besoin se fait sentir d'un format commun de compte-rendu pour les forces aériennes de l'OTAN, permettant l'emploi dans les rapports d'études d'une terminologie commune et de variables comparables. En outre, toute étude en coopération entreprise par les forces aériennes de l'OTAN exige un protocole et un accord relatifs aux variables à mesurer, aux points de prise de mesure et à la facon d'en faire rapport. Par ailleurs, il est impossible d'effectuer des études en collaboration sans qu'une attention méticuleuse ne soit apportée au contrôle de qualite de l'échocardiographie.

Le compte-rendu préliminaire portant sur une sur-représentation de l'hypertrophie du ventricule cardiaque droit des pilotes de Mirage 2000, par comparaison avec un nombre équivalent de pilotes d'aéronef de moindres performances de l'armée de l'air Francaise, souligne la nécessité d'examiner si les différences constatées sur les paramètres d'échographie entre les deux populations seraient confirmées à cet égard dans une étude multinationale importante. Ces études préliminaires débattues plus loins dans le présent document ont appelé notre attention sur la nécessité d'identifier les variables ou groupes de variables du plus grand intérêt pendant la surveillance du personnel navigant par échographie du coeur.

Le but du Groupe de travail (W.G. 13) de l'OTAN est double:

1. Mettre au point un format de compte-rendu pour des études d'échographie du coeur sur les personnel navigant,
2. Rédiger un protocole d'étude multinationale d'échographie, traitant de toutes les questions, sous forme d'avant projet expérimental d'étude échographie du coeur, d'un point de vue à la fois rétrospectif et prospectif.

La présente publication de l'AGARD consiste à exposer un protocole expérimental. Une attention toute particulière doit être apportée à:

- la section Procédure (comment exécuter le protocole),
- la section Technique (comment exécuter, enregistrer, mesurer et faire rapport des échocardiogrammes individuels).

Le document de travail de l'AGARD "Echocardiographie" préside à l'orientation de la section Procédures et à celle de la section Technique. Il traite de toutes les questions pertinentes de démographie, des données d'identification des sujets, des variables de comparaison en contrôle de qualité et en mesure sur les sujets, ainsi que de toutes les valeurs dans le mode M, en 2-D et en Doppler. Le tout dernier point (point #91) du document de travail ménage la possibilité d'ajouter dans le futur des identificateurs spéciaux de sujet, tels que l'emploi de systèmes spécifiques d'aide physiologique, de formes spécifiques d'exposition aux accélérations ou d'autres variables estimées importantes à l'avenir.

Une section importante couvrant les "operations calculateur" est incluse, qui traite de l'installation logicielle, de la présentation des données (découpage en fenêtres), des fonctions de base, options, annexes, limites de validité des variables, de la structure de cartes et elles comporte un glossaire des termes techniques. Le groupe de travail WG 13 éprouve une reconnaissance particulière à l'égard de son ingénieur informaticien, Mr Bertrand Piedecoq (C.E.R.M.A. Paris), qui a écrit les programmes calculateur du document de travail "Echocardiographie" de l'AGARD: il a rendu d'inestimables services au Groupe de travail en traduisant les décisions du Groupe sous format adapté à l'ordinateur. Le logiciel d'acquisition de données échocardiographiques est conçu pour recueillir les données et les stocker sur disque dur. Le logiciel des laboratoires d'échocardiographie de l'OTAN est fourni sous la forme de disquettes de 5¼ et 3½ pouces, du format PC IBM. Les disquettes fournies à chaque laboratoire participant permettent les "entrées" dans trois langues. Francais, Anglais ou Espagnol. Les disquettes vont être transférées à une base centrale de données (logiciel SAS), à la base aérienne de Brooks – Texas, à des fins d'archivage et d'analyses statistiques.

L'hypothèse "Nulle", qui est décrite dans le présent document, peut être traitée de facon adéquate avec 500 paires triees (N = 1000). Bien évidemment, un nombre beaucoup plus imporant de sujets est nécessaire pour obtenir 500 paires triees. Pour les paramètres considérés et à un niveau de différence significative de 10%, le Groupe de travail souhaite s'assurer d'une probabilité minimale de 95% (pour toute variable unique) de détecter une différence, si celle-ci est réelle. Pour quelques-unes des variables, cette probabilité minimale est de 99%. Cette taille d'échantillon garantit également que pour toute variable, la probabilité de déclarer une différence, alors qu'il n'y en a pas, ne dépassera pas 5%. Il n'est pas possible de connaître avec précision, à l'avance, la taille de l'échantillon, car la fourchette des données échocardiographiques au sein des équipages navigants aptes de l'OTAN n'a jamais été compilée. Il se pourrait que les données échocardiographiques de l'OTAN aient une fourchette plus faible et soient plus homogènes. Dans ce cas, les écarts standard des données d'échographie de l'OTAN pourraient être plus faibles que ceux publiés dans les documents cliniques de référence. Ainsi est-il nécessaire d'établir nos propres normes échocardiographiques dans l'OTAN. Avec une taille préliminaire d'échantillon de 250 puis de 500 sujets, la taille nécessaire de l'échantillonnage va être calculée. Si les données du personnel navigant de l'OTAN sont plus homogènes, comme on le pressent, ce facteur conduirait à réduire les spécifications d'échantillonnage.

En ce qui concerne la nécessité d'effectuer une étude de "profil longitudinal" de l'ensemble des élèves du personnel navigant, une décision pourra être prise à l'issue de l'étude de "profil transversal (par strates)". Dans une étude de profil longitudinal, chaque sujet fonctionne comme son propre contrôle; elle nécessite des informations Doppler codées en couleurs qui n'ont pas toujours été disponibles dans les études rétrospectives d'échographie du coeur. Les écarts standard des valeurs des données Doppler, pour des structures de coeur du côté gauche, sont si importants qu'une étude multinationale est la seule méthode praticable pour traiter des questions aéromédicales impliquant l'échographie du coeur.

La taille de population nécessaire afin de détecter des modifications faibles mais significatives sur le plan professionnel est probablement tout juste accessible dans un contexte multinational. La détection de lésions contractées de "reflux artériel", de modifications et la vitesse ou la duré d'éjection systolique, chez les équipages d'aéronef à hautes performances, exige un échantillonnage très conséquent si l'ont veut pourvoir détecter de petites modifications.

L'alternative avec des échantillons plus faibles, est de se contenter de ne détecter que des modifications flagrantes. L'étude suivie de ces questions de médecine professionnelle donne aux Nations de l'OTAN l'occasion d'exploiter l'une de leurs ressources médicales les plus précieuses, à savoir l'énorme réserve potentielle de l'information biomédicale mise en commun.

Le contrôle de qualité est l'une des questions majeures pour le Groupe de travail "Echocardiographie". Il est relativement simple d'effectuer une étude multicentres, si l'on se contente de communiquer des données sur disquette et de les collationner de manière centralisée. Il est très différent de s'assurer que les études ont été effectivement menées selon les spécifications du protocole, que toutes les mesures ont été effectuées avec les mêmes règles du domaine spatial et que les études sont toutes d'une qualité technique acceptable. Les questions de contrôle de qualité et les déterminants les plus importants de l'échantillonnage sont inextricablement liés. La taille d'échantillon est déterminée par la définition de ce que l'on percoit être une différence significative acceptable entre deux groupes pour une variable quelconque, la fourchette des données normatives, la variation propre au sujet, la variation particulière à l'observateur, la variation due au passage d'un observateur à l'autre, ainsi que de la définition que l'onse donne des paires triées. Un contrôle strict de qualité est un préalable à des études de variations. Ainsi, les trois types de variations sont-ils inextricablement liés à la taille d'échantillon qui, en dernière analyse, est liée au contrôle de qualité. On peut uniquement délimiter les variations sur des études de qualité primitive, dont les analyses sont aveugles et dont la qualité est assurée par une surveillance aléatoire. La délimitation des variations est au centre de la question des differences signficatives. Il faut abandonner tout espoir de détecter des différences que sont égales ou inférieures à la somme des trois types de variations communément utilisés dans les études scientifiques. Au fond, le travail ne fait que démarrer quand le recueil des données commence. Bien des études de faibles niveau statistique ne font en réalité que rapporter des accidents statistiques de procédure et de variation des sujets.

Le Groupe de travail 13 comprenait les membres suivants:

Air Com. D.Hull, Angleterre
Col. P.Vandenbosch, Belgique (Président)
Col. J.R.Hickman, Jr, Etats-Unis (Vice-Président)
Dr G.Gray, Canada
Col. P.Quandieu, France
Col. H.Ille, France
Lt Col. V.Navarro, Espagne
Lt Col. W.Kruyer, Etats-Unis
Maj. R.D.Latham, Etats-Unis

Le Groupe de travail a bénéficié du concours des observateurs et collaborateurs suivants:

Maj. M.Blick Docteur en Médecine, Cardiologue , USAFSAM
Mr B.Piedecoq Ingénieur Informaticien, France
Ms N.Hopper Chef Technicien Echographie, USAFSAM
Lt M-F.LaLiberté Spéc. Physiologie Aérospatiale, Canada
Mr B.Jackson Statisticien, Etats-Unis
Mr W.Nixon Chief, USAFSAM
Mr W.Besich Analyste Programme Informatiques, Etats-Unis

La répartition des tâches parmi les pays participants s'établit comme suite:

Logiciel d'Echocardiographie — France
Section Technique — Royaume-Uni et France
Section Procédures — Canada
Feuille de Travail des Données Echocardiographiques — Canada et France
Section Protocole — Etats-Unis
Contrôle de Qualité — Etats-Unis et Canada
Statistiques — Etats-Unis et France
Traduction Technique — Espagne et Royaume-Uni
Base de Données Centralisées — Etats-Unis

Les différents produits soumis à la Commission de Médecine Aérospatiale lors de l'achèvement des deux ans de travaux du WG 13 furent les suivants:

1. Feuille de travail des données échocardiographiques
2. Logiciel d'echocardiographie
3. Manuel de la documentation du logiciel
4. Section technique
5. Section procédures
6. Protocole expérimental

Tous ces produits, à l'exception de la documentation logicielle sont inclus dans cette publication AGARD.

Les membres du Groupe tiennent à remercier la Commission de Médecine Aérospatiale du soutien qu'elle leur a apporté. Ils adressent un remerciement spécial aux pays qui ont accueilli leurs réunions. Ms Margie Lee de l'USAF a rendu les inestimables services de transcription et de rédaction qui ont permis l'achèvement du présent document.

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* See Procedures Section, pages 26 to 33.

Multinational Echocardiographic Research Protocol

RESEARCH PROTOCOL

CARDIAC FUNCTION BY ECHOCARDIOGRAPHY IN MILITARY PILOTS

PERSONNEL TO CONDUCT STUDY:

Members of the NATO AGARD/AMP WORKING GROUP 13 (WG 13) serve as the Principal Investigators for this study.

Air Commodore David Hull, UK
Col Paul Vandenbosch, Belgium (Chairman)
Col James R. Hickman, Jr., U.S. (Vice Chairman)
Dr. Gary Gray, Canada
Medicin en Chief Pierre Quandieu, France
Col Henri Ille, France
Lt Col Vicente Navarro, Spain
Lt Col William Kruyer, U.S.
Maj Ricky D. Latham, U.S.

Each country desiring to participate is responsible for providing a Principal Investigator.

OBJECTIVES

1. Establish a standardization of the technique and format to record and report cardiac Doppler/echocardiograms performed in NATO aircrew members.
2. Establish normative data ranges for echocardiographically determined parameters in NATO aircrew.
3. Perform a cross-sectional study of echocardiography in high sustained G (HSG) pilots compared to non-HSG pilots (tanker, bomber, transport, or helicopter; TTB or HC).
4. Initiate a longitudinal study of echocardiography in HSG and TTB pilots from time of enrollment into flight training following variables at prescribed intervals up to 20 years post-graduation.

HYPOTHESIS:

GENERAL: There is no difference in cardiac chamber dimensions, wall thickness, or echocardiogram functional parameters between pilots who fly HSG aircraft and pilots who fly other types of aircraft.

This cross-sectional study is designed to produce reasonably immediate data. It is a cross-sectional design utilizing retrospective and prospective data in trained pilots. Complete data may not be available in all retrospective studies, but in order to achieve a sufficient denominator in a practical time period, all subjects who meet the minimum exclusion criteria may be included. Data may be derived from hard copy, echo tape, or reports. Quality control (QC) will be performed throughout the study, although limited

in scope for retrospective data.

SPECIFIC: Null Hypotheses

1. There is no difference in echocardiographically derived right ventricular dimensions in HSG pilots compared to non-HSG (TTB) pilots.
2. There are no significant differences in echocardiographically determined left ventricular, left atrial, or aortic dimensions in HSG pilots compared to TTB pilots.
3. There are no significant differences in echocardiographically-derived and Doppler indices of ventricular performance in HSG pilots compared to TTB pilots.

MILITARY APPLICATION

The study addresses the question whether the occupational exposure to flying HSG aircraft results in changes in cardiac dimensions or performance. The study will also serve to standardize the methodology for echocardiography in aircrew for NATO countries as well as establish an echo data base for participating countries which will lend itself to future epidemiological surveys in this population.

BACKGROUND

It is generally known that there are significant acute hemodynamic effects in humans upon transient exposure to high $+G_z$. Most of the quantitative data brought to bear on this issue have been acquired in animal studies. It is not known if repeated exposures to high levels of acceleration stress induce reversible or irreversible cardiovascular effects. It is further unknown whether any significant effects in cardiac function that may occur represent an "adverse" alteration with respect to operational performance or health safety. Finally, it is unknown if there is a dose threshold of high $+G_z$ exposure that induces adverse cardiac effects for either performance or reversibility.

In 1985 at the Athens AMP Symposium, Dr Henri Ille and colleages of France presented results of an echo study in Mirage 2000 pilots which implied significant alterations in parameters of right ventricular dimension.[1] In contrast, a similar review of echo data from fighter pilots in Belgium did not suggest a similar correlation.[2] Because of the significant implications but contrasting results of these preliminary reports, the AGARD/AMP WG 13 was compelled to formulate this internationally collaborative prospective study to provide a resolution to the question with adequate statistical power.

TECHNICAL APPROACH

Study Definitions - The following terms are defined as used in the study design.

1. HSG aircraft - Aircraft which is capable of and routinely flown using maneuvers sustaining a minimum of 7G for 15 seconds. Designated Class "A".

2. TTB aircraft - Non-HSG aircraft (not meeting criteria of definition #1), which includes two classes:
   a. Class C, which is 1G aircraft only, such as transport or tankers, as well as nonhigh-performance helicopters.
   b. Class B, an intermediate class between A and C, which is aircraft capable of greater than 1G maneuvers but not meeting criteria for Class A. This includes aircraft such as the F-4 or F-111 and high-performance attack helicopters.
3. Retrospective Echo - Echo previously performed for reasons other than cardiac referral, which will be used for the cross-sectional study.
4. Prospective Echo - Echo performed in a trained pilot for purposes of the cross-sectional study protocol in accordance with procedures and techniques outlined in the Procedures and Technical Sections.
5. Longitudinal Study Echo - Echo performed specifically for a longitudinal follow-up study, beginning with pilot candidates, using the same procedures and techniques applied to cross-sectional prospective echoes.
6. Graduate Pilot - Aircrew member who has completed flying training, received his flying wings, and is currently on flying status.
7. Pilot Candidate - Enrolled or accepted into flight training school and not having received flying wings (not achieved wing standard) who will be a subject for the longitudinal study only.
8. Exercise history will be divided into two definitions:
   a. Isometric exercise refers to all types of weight training, including free weights or Universal/Nautilus types of equipment.
   b. Aerobic exercise refers to all other forms of sports activities.
9. Echo-derived indices of ventricular performance refers to all Doppler-derived determinations of flow velocities, ejection times, Vcf, EF slope, and other post-hoc calculations from measured echo variables (i.e., wall stress).

Study Design

This study of echocardiography in pilots will consist of two phases. First, a cross-sectional study will be performed in graduate pilots, and second, a longitudinal study will be initiated in pilot candidates. The cross-sectional investigation will be used as the pilot study for the longitudinal study. The cross-sectional study will evaluate various echocardiographically-determined variables across the range of flying time in the average pilot population by performing a single echocardiogram in a significant number of NATO pilots with varying levels of flying experience. The echo-derived measurements of cardiac morphology and function will be characterized as a function of flying time, age, and type of aircraft flown.

In this study we are interested in comparing pilots of HSG aircraft with pilots of non-HSG aircraft. Although many indices of cardiac function and morphology will be tested, those related to right heart dimension and performance are especially important as suggested by preliminary studies. Because it is known that some changes in cardiac enlargement or wall thickness secondary to some physiologic stress (such as hypertension) will regress when the stress is removed, we will record specifically the pilots' flying activity and exercise history for the 6 months prior to the echocardiographic examination. Since possible regression of physiologic changes is a confounding variable which cannot be controlled, subjects with no flying time in the previous 36 months prior to the echocardiogram will not be enrolled.

Any differences in parameters between HSG and non-HSG pilots may be associated with variance in exercise histories, or are most likely to be found in subject groups with the most flying hours. Thus, a cross-sectional study which cuts across the whole of the rated aircrew experience would allow a more immediate determination of any differences in the high-time subgroups than possible from a longitudinal study. Furthermore, the cross-sectional study will serve as a guide for more specific emphasis or evaluations to be performed in the longitudinal study.

Given that small physiological differences are being sought, careful control of cofactors is essential to this study. The HSG and non-HSG pilot groups must be matched as closely as possible for age, flying time, and exercise history. Other cofactors are given below. Additionally, because the small differences expected in physiologic measurements and the nature of the media used for recording data, quality control will receive significant emphasis throughout the study. Thorough QC procedures will be instituted to prevent contamination of the data base with erroneous entries.

Data to be entered into the cross-sectional study may either be retrospective in form from data files or prospectively obtained. Stringent exclusion criteria must be met whether data is retrospective or prospective in nature and both forms of data will be subject to QC review. To maintain as similar a population as possible, only pilots will be included. Since the type of flying (HSG or non-HSG) is crucial to the hypothesis being tested, subjects with a mixed flying history will be not be enrolled.

To ensure similar data entry, a detailed technical worksheet has been devised. The AGARD/AMP ECHO WORKSHEET is accompanied by a PROCEDURES SECTION which clarifies all entries in detail and a TECHNICAL SECTION which describes the methodology of measurement for echo variables. Each participating country will be trained in the use of these materials. Each subject enrolled must have an Echo Worksheet completed which will be forwarded, along with the floppy disk which includes that subject's data, to the AGARD/AMP ECHO DATA BASE MANAGER at USAFSAM, Brooks AFB, Texas. Although all age groups and levels of flying experience will be included in the cross-sectional study, emphasis will be given initially to the pilot groups with the most flying time, since it is in this subgroup where differences are most likely to be found.

Exclusion Criteria

Absolute Exclusions for Cross-Sectional or Longitudinal Subjects

1. Presence of known cardiovascular disease prior to enrollment into the protocol
2. Use of cardiovascular drugs, except lipid-lowering agents
3. Clinically diagnosed pulmonary disease
4. Unavailability of any exercise history
5. Unavailability of flying history
6. Female sex
7. Unacceptable echo quality
8. Age less than 18 or more than 55 years
9. Concurrent transport and fighter flying
10. Referral for aeromedical cardiovascular evaluation
11. No flying in previous 36 months (cross-sectional study only)

Additional Exclusions for the Longitudinal Study

1. Echo data must include M-mode, 2-D, and color Doppler
2. Graduate pilot
3. Previous high-performance fighter exposure
4. Unavailability of a Type II exercise history

Each subject enrolled will also provide a detailed chronological flying history, to include total number of hours, number of hours in the last 6 months, and type of aircraft. Other cofactors to be recorded will include a smoking history, total and HDL cholesterols, height, weight, and blood pressure sitting and supine.

Exercise History

An exercise history will be taken for each subject enrolled. For the retrospective cross-sectional study, this will be a semi-quantitative scale from 1-4 for aerobic and isometric (weight training) activity. Exercise is considered a critical cofactor in the study, and a subject cannot be entered without an exercise history. Two types of exercise history have been defined: a simplified, semi-quantitative history (Type I) and a detailed quantitative history (Type II). For retrospective data, a Type I exercise history is sufficient. For prospective studies, a Type II exercise history should also be obtained. The Type II history attempts to more precisely quantitate exercise activity over the previous 6 months in terms of kjoules per week (kj/week), both aerobic and isometric exercise.

The definitions of the categories for levels of activity for the Type I history are outlined in the Procedures Section. Sports activities for the Type II history are attached to the end of the Echo Worksheet.

Echo Parameters

A detailed description of the technique of recording and measurement for each of these variables is given in the Technical Section. A list of the echo variables to be measured is as follows:

For retrospective data, only M-mode parameters will be used.

1. RVD (right ventricular dimension) - 2-D-directed M-mode at level of deep left ventricle, end-diastole at onset of Q wave
2. $LVID_{ed}$ - Left ventricular internal dimension at end-diastole
3. $LVID_{es}$ - Left ventricular internal dimension at end-systole
4. IVS_{ed} - Intraventricular septum thickness at end-diastole
5. $LVPW_{ed}$ - LV posterior wall thickness at end-diastole
6. LA - Left atrial dimension at peak systolic excursion of Ao
7. Ao - Aortic dimension at end-diastole
8. IVS_{es} - Peak IVS thickness at end-systole
9. $LVPW_{es}$ - Peak LVPW thickness at end-systole

For prospective data, 2-D and Doppler measurements will be added.

1. Long-Axis Parasternal
   Ao dimension/systole
   LA dimension/systole
   RV dimension/end-diastole
2. Short-Axis (below mitral valve and above papillary muscles)
   RV internal dimension/diastole
   LV internal dimension/diastole
   LV internal dimension/systole
   IVS thickness/diastole
   IVS thickness/systole
   PW thickness/diastole
   PW thickness/systole
3. Apical 4-Chamber View
   Maximum RVID/diastole
   RV area/diastole
4. Doppler Measurements
   Required:
      Pulsed-wave Doppler
      Continuous-wave Doppler
      Color-flow Doppler
   Aortic Flow
      Peak velocity
      LV pre-ejection time
      LV ejection time

Acceleration time

Heart rate

Pulmonary Flow

Peak velocity

RV pre-ejection time

RV ejection time

Acceleration time

Heart rate

All data will be recorded on the Echo Worksheet.

Statistical Analysis

Sample size estimates for M-mode and 2-D measurements were made using population norms published in the Feigenbaum text.[3] A sample size of 500 matched pairs will detect a 10% difference in 23 parameters at a power more than 90% for all parameters measured. The concern, however, focuses on controlling for age and flying hours. Each age bracket or experience hours cell must meet the appropriate minimal sample for fighter pilots (HPF) and transport pilots (TTB or HC). It is expected that, if any divergence in parameter means is to be found, it is more likely in older pilots with greater flying hours. These cells must have an adequate number of subjects. Repeat estimation of necessary sample size will be performed after every 250 subjects enrolled to use the standard deviations from the population studied.

The specific hypothesis regarding the single dependent variable of RV dimension will be tested using an analysis of covariance adjusted for age. Additional covariates of flying hours and exercise score will be included with a second covariate analysis. If the HSG and non-HSG populations are very well age-matched, the delta RV dimension (difference between HSG and non-HSG pilots) will be plotted as a function of the flying hours for the HSG pilots. A positive effect will be demonstrated if the slope of this relationship is significantly different ($p<.05$) from 0.

For the second specific hypothesis involving the left heart measurements, a multivariate analysis of all dependent variables simultaneously will be performed. The variables are physiologically dependent upon one another and should be analyzed in a simultaneous fashion to assess co-dependence.

The third specific hypothesis will be tested using a Bonferroni correction due to the large number of variables to be included. Categorization of the population will be performed and a log-linear model may be applied. Additionally, using norms that have been determined, classes of pilots (depending on their cardiovascular characteristics) will be established so that an aviator may be predictably assigned to a particular class.

Finally, we will statistically evaluate three types of variability in this study: intraobserver, interobserver, and within-subject variability. These relationships will be determined using an extensive QC procedure whereby approximately 5% of all

echoes are reviewed by other readers or the original echocardiographer. A detailed description of the procedure to assess variability is given in the Procedure Section.

Quality Control

All prospective studies and 5% of the retrospective studies will be sent to the USAFSAM Echo Data Base Manager for quality control review. Procedure for QC is given in the Procedures Section. It is preferable that one central laboratory be responsible for QC review. Given the need to review echoes from several countries, compatible equipment that allows display of recorded tapes is essential. Cases from original videotapes will be randomly selected and dubbed to a QC tape without any of the subject demographics or measurement calipers included. This tape will be sent back to the original echocardiographer for repeat measurement to obtain intraobserver variability. Members of the QC center will read videotapes sent from other labs to provide the interobserver variability. Repeat echoes on the same subject several days apart will provide the within-subject variability. A separate data base will be maintained for both QC and variability.

Data Entry

Each country will be responsible for data entry onto a floppy disk using a customized data entry program. The data entry will be transcribed from an Echo Worksheet. Both the Worksheet and floppy disks will be sent to USAFSAM where repeat data entry will be performed and compared to the initial entry. This will serve to help eliminate transcription errors using dual entry by independent personnel with computer cross-check. This is a necessary precaution to prevent the data base from becoming contaminated with erroneous data.

The focus of activity involved in this study centers around completing the Worksheet. Each participating country is responsible for the logistics of obtaining echoes and completing the Worksheet. Using the "Pilots" data entry program developed at C.E.R.M.A. in France, each country will transcribe study data from the Worksheets into a computer file. After accumulating a number of subjects, the floppy disks with the data entered as well as the Worksheets will be forwarded to the data base manager at USAFSAM.

REFERENCES

1. Ille H, Didier A, Allegrini N: Selection et Surveillance Medicales des Pilotes de Mirage 2000: Apport de l'echocardiographie. AGARD Conference Proceedings No. 396, p. 32-1, 1985.
2. Vandenbosch PA, Vastesaeger JP: A Longitudinal Study of Echocardiographic Parameters by F-16 Pilots. Aviat Space Environ Med 60(5):493, 1989.
3. Feigenbaum H: Echocardiography. Philadelphia: Lea & Febiger, 1984.

FACILITIES TO BE USED

1. Respective to each participating country
2. Clinical Sciences Division, USAFSAM, Brooks AFB, Texas

TIME TO INITIATE STUDY

The cross-sectional data entry will begin during the c. endar year 1990. The accompanying Procedure and Technical Sections and other documentation meet Objective #1 to provide a standardized format for reporting echocardiograms.

PERSONNEL TO CONDUCT STUDY

The NATO AGARD/AMP WG 13 will serve as the study coordinator, depending upon appropriate extensions, and provide administrative oversight as well as assume responsibility for data analyses.

Each country is responsible for providing a Principal Investigator(s) and providing the necessary equipment, funding, and administrative support needed for data collection.

FUNDING IMPLICATIONS

1. Each participating country will be responsible for funding travel for the Principal Investigators to meet to discuss initial study progress and data analysis. Respective countries will be responsible for providing the computer support needed and necessary postage for data to USAFSAM.
2. Due to the crucial need for adequate QC, funds are needed to obtain the hardware necessary to review videotapes from countries outside that of the QC center at USAFSAM. Funds are also needed to obtain an echo videoprocessor unit with an interface to the USAFSAM/NG data base computers.

DATE PREPARED: 20 September 1989

PUBLICATION OF FINDINGS

To prevent premature publication of results with low statistical power, the results will be distributed and/or published only after all data analyses are completed and the WG 13 reviews and consents to release of findings. Some Principal Investigators may then wish to further analyse subsets of data to test very specific hypotheses. Anonymity of all subjects entered into the study will be maintained.

(Signature of Investigator)	(Signature of Certifying Official)
(Title)	(Title)

Procedures Section

INTRODUCTION

Military flying in high-performance fighter operations involves repetitive exposures to high sustained G (HSG) with marked changes in regional systemic and pulmonary vascular pressures related to both accelerative forces and respiratory straining maneuvers carried out to help maintain arterial blood pressure and cerebral blood flow. It is not surprising that questions arise as to whether repetitive exposures to HSG over the course of a career might induce changes in cardiac structure or function. Such changes might be temporary or permanent, reversible or irreversible. An early report from the Centre Principal d'Extertises Medicales du Personnel Navigant, in which a group of 34 fighter pilots were found to have right ventricular enlargement when compared with a group of 32 transport pilots, suggested that such concerns may be valid.

At the AGARD Aeromedical Panel meeting in Portugal in 1986, a decision was made to initiate an AGARD/AMP Working Group in Echocardiography. Working Group (WG) 13 was convened in 1988 to develop protocols for studies designed to address the concerns regarding potential cardiac health risks in HSG flying. By pooling data from NATO aircrew in cooperative studies, it is anticipated that answers to these important questions can be derived in a timely and substantial fashion.

OBJECTIVES

The following were defined as objectives for WG 13:

1. To devise a standardized method for recording and reporting echocardiographic data in NATO aircrew for research purposes. This standardization shall include a detailed analysis of which parameters are to be recorded, where they are to be measured, and how the data are to be collected, quality controlled and analysed. The WG shall also enumerate the clinical cofactor data and demographic data which must be reported in order to use the echocardiographic data.
2. To devise a protocol and reporting format for two studies:
   a. A cross-sectional echocardiographic study, to be carried out on current NATO pilots
   b. A prospective study to be carried out on presently untrained aircrew in a longitudinal fashion.

DESCRIPTION OF THE STUDIES

WG 13 has designed a format for standardized collection and storage of quality-controlled echocardiographic data and certain relevant cofactors in NATO aircrew. The protocols for two studies have been established to answer the question of possible structural cardiac abnormalities associated with HSG flying. In both studies, a number of interactive cofactors, including exercise and flying history, have been identified and will be controlled. Data for each subject will be collected on an AGARD/AMP ECHO WORKSHEET, and then entered in an MS-DOS-based file on floppy disks. Data collected in

individual countries will be forwarded to the AGARD/AMP ECHO DATA BASE MANAGER at USAFSAM for entry in the AGARD/AMP ECHO DATA BASE. Collation of the data will permit an extensive definition of echocardiographic norms for this particular population, as well as analysis of potential differences of echocardiographic parameters in population subsets. Careful quality control of the echocardiographic data has been incorporated in the protocol. The quality control program has been designed to allow evaluation of variation due to inter- and intra-observer differences and to subject physiologic variation.

A. CROSS-SECTIONAL STUDY

HYPOTHESIS: There is no difference in cardiac chamber dimensions, wall thickness or functional cardiac parameters between pilots who fly HSG aircraft and pilots who fly other types of aircraft.

The cross-sectional study will allow collation of data available on current NATO pilots, and will compare echocardiographic data from pilots flying HSG aircraft with data from pilots flying other, non-HSG aircraft. Subjects from the two groups will be matched in the statistical analysis for a number of cofactors, including exercise, age, and flying experience.

Echocardiographic data for the cross-sectional study may be derived retrospectively, i.e., from echocardiograms performed in the past on NATO pilots, or prospectively, i.e., from echocardiograms done concurrently on presently serving NATO pilots.

Data obtained from retrospective echocardiograms may be limited, but must include certain essential M-mode parameters (see exclusion criteria). Such data may be derived from hard copy, tapes, or reports. Certain cofactor information must also be available for retrospective subjects, including a semi-quantitative exercise history and a flying history (see exclusion criteria).

Echocardiograms done concurrently (prospective echoes) for the cross-sectional study on presently serving pilots will include M-mode, bidimensional, and Doppler data. Both a semi-quantitative and a detailed quantitative exercise history will be obtained at the time of the echocardiogram, along with a comprehensive flying history.

This study is designed to produce reasonably immediate date. A sample size of 500 matched pairs is targeted.

B. LONGITUDINAL STUDY

HYPOTHESIS: There is no difference between pilots of HSG aircraft and pilots of other aircraft in the development of changes in cardiac dimensions, wall thickness, or cardiac functional parameters over the course of a flying career.

The cross-sectional study has a number of limitations, including limited quality control on retrospective echoes, only basic echo data and limited cofactor data. The advantages are that reasonably immediate data will be available.

The inadequacies of the cross-sectional study are addressed in the longitudinal study protocol. This long-term longitudinal study will address the question of serial changes over time, and will allow a more refined control of cofactors and quality control. Baseline data will be collected on NATO pilot candidates before achieving wings standard. Follow-up studies will be performed on these same individuals every 24 months, plus or minus 6 months, for up to 20 years. Each subject will serve as his own control, and the analysis will compare pilots of HSG aircraft with a well-matched control group of pilots of non-HSG aircraft.

Since this study will follow pilot trainees over time, it is clearly a "long-term" study which will require at least five years before even any interim data is available. Analyses from the cross-sectional study will be used to determine population size.

EXCLUSION CRITERIA

Absolute Exclusions / Cross-Sectional and Longitudinal Studies

1. Aircrew other than pilots
2. Presence of cardiovascular disease
3. Use of cardiovascular drugs, except lipid-lowering agents
4. Clinically diagnosed pulmonary disease
5. Female sex
6. Unacceptable echo quality, or lack of essential echo parameters
7. Age less than 18 or greater than 55
8. Lack of an adequate exercise history
9. Lack of an adequate flying history (total flying hours and hours in past 6 months minimum required)

Additional Exclusions for the Cross-Sectional Study

1. Not eligible for flying duties at the time of the echocardiogram
2. No flying hours in the 36 months prior to the echocardiogram
3. A mixed fighter/transport flying history (previous jet trainer flying is acceptable)
4. Unavailability of a Type I exercise history for retrospective subjects, or a Type I and Type II exercise history for prospective subjects
5. Echocardiogram done for suspected cardiac disease
6. Lack of essential echo parameters, specifically, M-mode RVIDD, LVIDD, LVID, IVSS, IVSD, LVPWD, LVPWS, LA and AO

Additional exclusions for the Longitudinal Study

1. Incomplete echo data: Lack of M-mode, 2-D, color-flow or Doppler data
2. Achievement of military wings at the time of the initial echocardiogram
3. Previous HPF exposure
4. Unavailability of a Type I and Type II exercise history

SELECTING SUBJECTS FOR THE STUDIES

Subjects for the cross-sectional study will be drawn from currently serving NATO pilots. The results of echocardiographic studies previously carried out (retrospective echoes) on current pilots may be used, whether these studies were carried out for routine surveillance or as part of an aeromedical evaluation, provided the studies were not done for suspected cardiovascular disease. The various exclusion criteria listed above for the cross-sectional study must be satisfied. If previous echo studies are used, the biographic/cofactor data pertinent at the time the echo was performed should be entered in the data base. An accurate Type I exercise history valid at the time of the echo is essential.

Subjects for the cross-sectional study may also be selected in a prospective manner, by performing echoes on currently serving pilots. In prospective studies, a complete echo study, including M-mode, 2-D and Doppler echoes, should be carried out and a Type II exercise history and detailed flying history obtained. In selecting prospective subjects, priority should be given to more experienced pilots.

For the longitudinal study, subjects initially will be pilot candidates or trainees prior to wings graduation. These studies may be part of the normal selection screening process in some countries, or may be carried out specifically for the AGARD/AMP study. The exclusion criteria listed above must be satisfied.

REASON FOR THE STUDY

Included on the Worksheet is a question pertaining to the reason for each particular study. This information will be included in the data base.

1. Specifically for AGARD/AMP Echo Study
2. Selection for flying training
3. Routine surveillance of experienced aircrew
4. Noncardiovascular aeromedical evaluation
5. Duplicate study for variation data base
6. Repeat study because original echo unacceptable

SUBJECT IDENTIFICATION CODE / CONFIDENTIALITY

Each subject will be identified by a unique Identification Code Number which will be assigned by the home country, with the following format:

__ __ / __ __ __ / __ __ __ __ __

country code / alphanumeric / 5-digit identifier

The country code refers to the home country of the subject.

Belgium	Ø1	FRG	Ø5	Norway	Ø9	UK	13
Canada	Ø2	Greece	Ø6	Portugal	1Ø	USA	14
Denmark	Ø3	Italy	Ø7	Spain	11	Sweden	15
France	Ø4	Netherlands	Ø8	Turkey	12	Other	16

The 3-letter alphanumeric can be used by the home country as desired. One possible use would be to identify different groups of aircrew, e.g., HSG - high sustained G subjects; TSP - transport and other nonhigh sustained G pilots.

Example: 02/HSG/00001 might be a Canadian pilot flying HSG aircraft
14/TSP/10020 might be a USAF tanker pilot

Since subjects will be identified only by the Identification Code Number in the study data base, there will be no way of linking any unique data with a particular individual. The method of handling confidentiality in each participating country will be left to the discretion of the investigators in that country.

DEMOGRAPHIC / BIOGRAPHIC COFACTOR DATA

Certain cofactor data are considered integral to the echo variables under consideration. These cofactor variables are described below. The data for each will be entered on the Worksheet and in the data base for each subject. The absence of data for these cofactors, except as defined under Exclusions Criteria above, would not preclude entering a subject in the study.

Age must be between 18 and 55 years inclusive

Smoking - Smoking history will be recorded in the data base in terms of pack-years; smoking one package of 20 cigarettes per day over a period of one year equals one pack-year. The following equivalences apply for other tobacco products.

20 cigarettes ~ 6 cigarillos
~ 3 cigars
~ 3 bowls of pipe tobacco

Individuals who quit smoking will be considered as "current smokers" until one year after smoking cessation, then as ex-smokers. The Worksheet will query smoking history based on cigarettes, cigarillos, cigars, or pipe smoking, and pack-years will automatically be calculated.

Cholesterol - Cholesterol and HDL cholesterol should be drawn after a minimum 8-hour fast. Units will be milligrams (mg) per deciliter (dl). The data base will query values for total cholesterol below 170 or above 260 mg/dl, and will not accept values below 100 or above 500 mg/dl. For HDL, the corresponding "query"/"reject" values are 30/70 mg/dl and 15/150 mg/dl.

Height measured without shoes. Entered in centimeters (cm) to the nearest centimeter.

Weight measured in underclothes, to the nearest kilogram.

BSA will be automatically calculated from the height/weight according to the formula $H^{.725} \times W^{.425} \times 0.007184$.

Blood Pressure measured in mmHg, with an appropriate-sized cuff. Blood pressure must be recorded and entered in both the sitting and supine positions. The

data base will query values for systolic blood pressure below 110 or above 150 mmHg, and will reject values below 90 or above 200 mmHg. The corresponding "query"/"reject" values for diastolic blood pressure are 60/90 and 40/120 mmHg.

Exercise History - Exercise is considered a critical cofactor in the study, and a subject cannot be entered without an exercise history. Two types of exercise history have been defined: a simplified, semi-quantitative history (Type I), and a detailed quantitative history (Type II). For subjects with retrospective echoes in the cross-sectional study, a Type I exercise history is sufficient. For prospective subjects in the cross-sectional study, both a Type I and a Type II exercise history should be obtained at the time the study is performed. For subjects in the longitudinal study, a Type II exercise history is also required.

The Type I exercise history will rate the individual for both aerobic and isometric-type exercise in one of the following categories:

1. Basically sedentary
2. A light exerciser
3. A moderate exerciser
4. A regular, very vigorous exerciser

For aerobic exercise, the following descriptives may help in appropriate classification:

1. Sedentary - An individual with no exercise program. Uses car to go to work. Walks less than 1 mile (1.5 km) daily. Uses elevator when available. Leisure pursuits are all aesthetic/intellectual, and involve negligible physical exertion.
2. Light - Exercise program nonexistent or often neglected. Walks 1-2 miles/day (1.5-3 km), e.g., to work or exercising the dog. Often uses stairs if climbing only 1 or 2 floors. May engage in golf, country walks on weekends. Cycles occasionally, short distances (<2 miles or 3 km). May do 2-4 hours of yard work per week. Exercise program less than 3 times/week.
3. Moderate - Has an exercise program. Participates at least 3 times/week. Jogs several times weekly, but up to 20 miles/week (30 km) only (or other equivalent aerobic exercise). Regular, energetic leisure pursuits, e.g., squash or other court games 2-4 times/month. Yard work 4-8 hours/week. Keen do-it-yourselfer at home. Walks, uses stairs whenever possible. Bicycles regularly, 10-25 miles/week (15-40 km).
4. Regular/Heavy - Punctual observance of exercise program. Jogs or runs several times weekly, more than 20 miles (30 km) most weeks, or equivalent exercise. Keen on competitive sports or

meeting physical challenges. Nearly all leisure pursuits involve taxing physical exertion. Prefers to walk fast (>4 mph, 7 kph), runs up stairs unless more than 8 flights. Massive alterations to home and yard.

For isometric-type exercise, the following descriptives apply:

1. Sedentary - No isometric exercise. No formal muscle-developing program.
2. Light - Regular program of muscle-developing exercise, but less than 60 minutes/week.
3. Moderate - Regular program of muscle-development, 1-3 hours/week.
4. Regular/Heavy - Vigorous program exceeding 3 hours/week.

The Type II exercise history involves a quantitative estimate of weekly energy expenditure over the 6 months prior to the echocardiographic study. A detailed exercise history is obtained using the Type II Exercise History Questionnaire. The investigator should attempt to get as accurate an estimate as possible of the subject's activities over the previous 6 months by having him complete the questionnaire, which is an appendix to the Worksheet. The data can then be transferred to the data entry program, which will automatically calculate energy expenditure in kj/week.

The "Weight Training" question must be answered accurately. The data entry program will separately calculate isometric and aerobic energy expenditure.

Flying History - The flying history is also a critical variable and is required to enter a subject in the study. The aim is to derive as close an estimate as possible of the total and recent exposure to HSG. An attempt is also made to estimate the recent exposure to HSG in various fighter operational roles.

A complete flying history is mandatory for subjects in the longitudinal study. At the time of each echo, the subject must complete the military flying history question on the Worksheet, which lists in chronologic order each aircraft in which the subject has flown a minimum of 50 hours.

For retrospective subjects in the cross-sectional study, total flying hours, total flying hours in HSG aircraft, and flying hours in the past 6 months are essential. For prospective subjects in the cross-sectional study, the complete military flying history should be obtained.

DATA BASE INSTRUCTIONS

Data on individual subjects will be collected on the Echo Worksheet. Data should then be transferred to the AGARD/AMP ECHO DATA BASE DATA ENTRY PROGRAM, which requires an IBM/AT compatible computer. The data base is based on MS-DOS. Programmed data entry disks with instructions are available from the AGARD/AMP ECHO DATA BASE MANAGER at USAFSAM, at the following address:

AGARD/AMP ECHO STUDY
USAFSAM/NGI
Brooks AFB, Texas
USA 78235

Attention: Ms. Hopper, Bldg 110, Room 137

Telephone: AUTOVON 240-3242

Commercial (512) 536-3242

Data floppy disks should be forwarded at monthly intervals with the corresponding worksheets and videotapes (for prospective echoes). A copy of each data floppy disk, Worksheet, and videotape should be kept in case of loss of the original in transit. A return address and telephone number should be included.

For countries without access to an IBM compatible computer, the Echo Worksheets may be forwarded directly to the above address for entry in the data base program.

DATA STORAGE

Each country must retain indefinitely the tapes, data disks, and Worksheets on each subject for later review if required.

QUALITY CONTROL

Quality Control (QC) is central to the accuracy and precision of the data base. (Fig. 1)

1. The USAF School of Aerospace Medicine (USAFSAM) will perform the QC for the cross-sectional and longitudinal studies. A report of QC results will be sent periodically to each participating country's point of contact. If there is an unresolved disagreement between the QC center and a participating country regarding echo measurements, the disagreement will be referred to DCIEM Central Medical Board, Toronto, Canada, for arbitration.
2. For the cross-sectional study, QC will be performed on samples of studies performed prospectively and on samples of studies performed retrospectively if videotapes or hard-copy M-mode studies are available. Retrospective studies without videotapes or hard copies may be used in the cross-sectional study but will not be accessible for QC. All echoes for the longitudinal study will be obtained prospectively and will therefore be accessible for QC.
3. For QC of M-mode studies, paper hard copies are preferred to videotapes. Videotapes are required for QC of 2-D and Doppler studies. Each M-mode hard copy and each videotape should have a cursor demonstrating where the measurements were taken. Original tapes should be sent for QC review. Duplicate tapes should be kept by the local echocardiographic laboratory in the event the original studies submitted for QC are lost in transit.

4. Retrospective echoes for the cross-sectional study. Completed AGARD/AMP Echo Worksheets and the computer data floppy disks of all these studies will be sent to USAFSAM. The Worksheets must be appropriately checked in Item 1 as to whether the original echo study is available for review. Of those available for review, USAFSAM will request that 5% of randomly selected studies be forwarded for QC review.

5. Prospective echoes for the cross-sectional or longitudinal studies. All M-mode hard copies, videotapes, Worksheets and computer data floppy disks will be referred to USAFSAM each month. If only a small number of studies are done per month by a particular country, these items may be sent every two or three months instead.

6. Three types of review will be carried out.

   a. USAFSAM will randomly select 5% of echo studies from each country for QC review for acceptability of recording quality and accuracy of parameter measurements.

   b. Separate measurements of the same 5% of echo studies will be performed to determine inter- and intra-observer variation of parameter measurements.

   c. A separate assessment of duplicate echo studies in a different 5% of subjects will be carried out to determine the range of physiologic variation in the defined echo parameters.

These 3 review processes/methods are further discussed in the following 3 paragraphs.

7. Each participating country will send its first videotape of prospective echo studies (minimum of 5 studies) to USAFSAM for review as soon as that videotape is completed. This first tape will be reviewed for errors of recording technique. Thereafter, each country will forward all studies as described in paragraph 5 above. USAFSAM will randomly selected 5% of the studies from each country for QC review. Each study selected for QC review will be assessed initially for acceptability for measurements. If unacceptable, it will be referred back to the participating country and the data deleted from the database. A repeat echo may be performed on the same subject and resubmitted, which will be subject to QC review.

8. USAFSAM will then prepare duplicate videotapes of the 5% of QC tapes randomly chosen from each country which pass QC review. This recording will not include cursors or other measurements appearing in the original recording. USAFSAM measurements of these duplicate studies will be recorded on an abbreviated Worksheet labeled "For Intra/Inter-Observer Variation."

The duplicate videotape and blank abbreviated Worksheets will be sent to the country of origin for repeat interpretation by the original reader. The name of the original reader will be recorded on the abbreviated Worksheet. Completed abbreviated Worksheets will then be returned to USAFSAM. The data obtained from the original

reading and the repeat findings at USAFSAM and the country of origin will be used to calculate intra- and inter-observer variation of measurements.

9. Each participating country will locally select a separate 5% of echo studies of high technical quality for repeat echocardiography. The repeat echo study may be done the same day (morning and afternoon) or on a different day. Both echo studies will have an AGARD/AMP Echo Worksheet appropriately completed. For Item 2 of the repeat study, "Reason for Study," number v. "Duplicate study for variation data base" should be checked. All such studies will be forwarded to USAFSAM to determine physiologic variation of measurements.

10. For QC purposes, measurement differences (QC Center compared with country of origin) of up to 25% for wall thickness measurements and up to 10% for all other parameters will be considered acceptable. Unacceptable measurement differences for a study are defined as:

    a. For a single parameter, a difference exceeding 40% for left ventricular wall thickness or 20% for any other parameter

    b. For the overall study, no more than 20% of all parameters may exceed the acceptable limits defined above.

Studies considered to have unacceptable measurement differences will be returned to the country of origin for review. If the disagreement of measurements is resolved, the corrected measurement(s) will be entered into the data base for that subject. If not, the study may be referred to DCIEM for arbitration. A flow sheet of the QC process is Figure 2.

11. The mailing address for the Quality Control Center is

AGARD/AMP ECHO STUDY
USAFSAM/NGI
Building 110, Room 137
Brooks AFB, Texas
USA 78235

telephone: AUTOVON 240-7232

Commercial (512) 536-3242

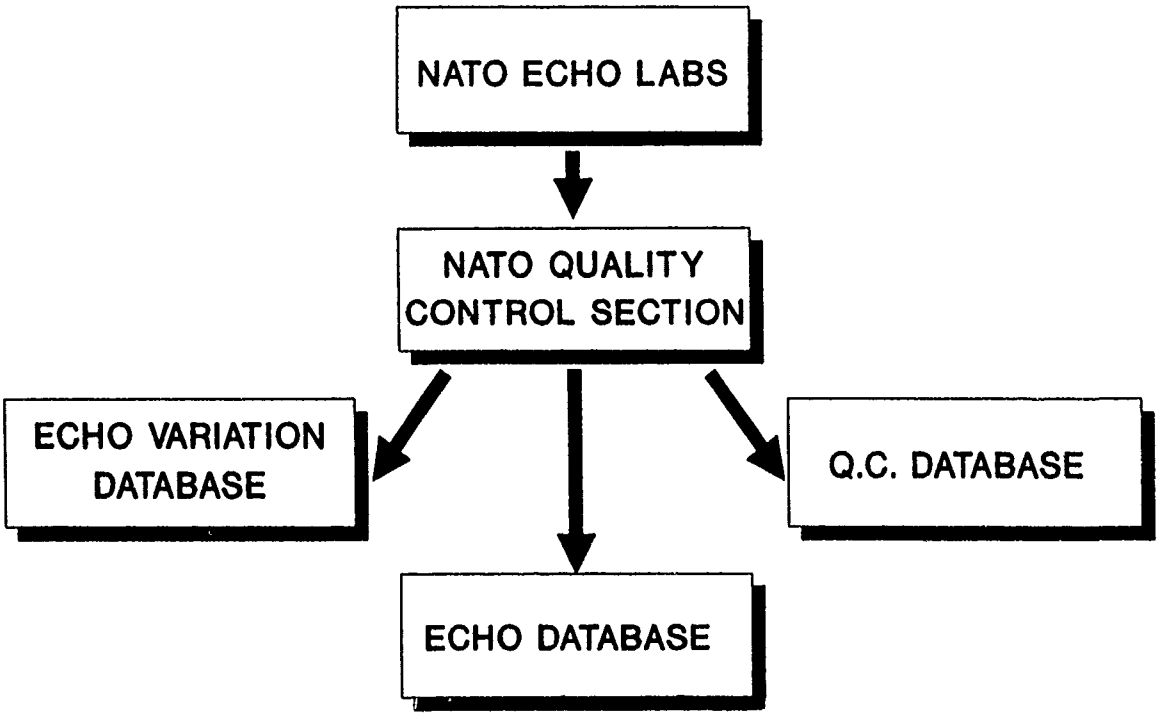


Figure 1. Relationship of Quality Control to the Data Bases

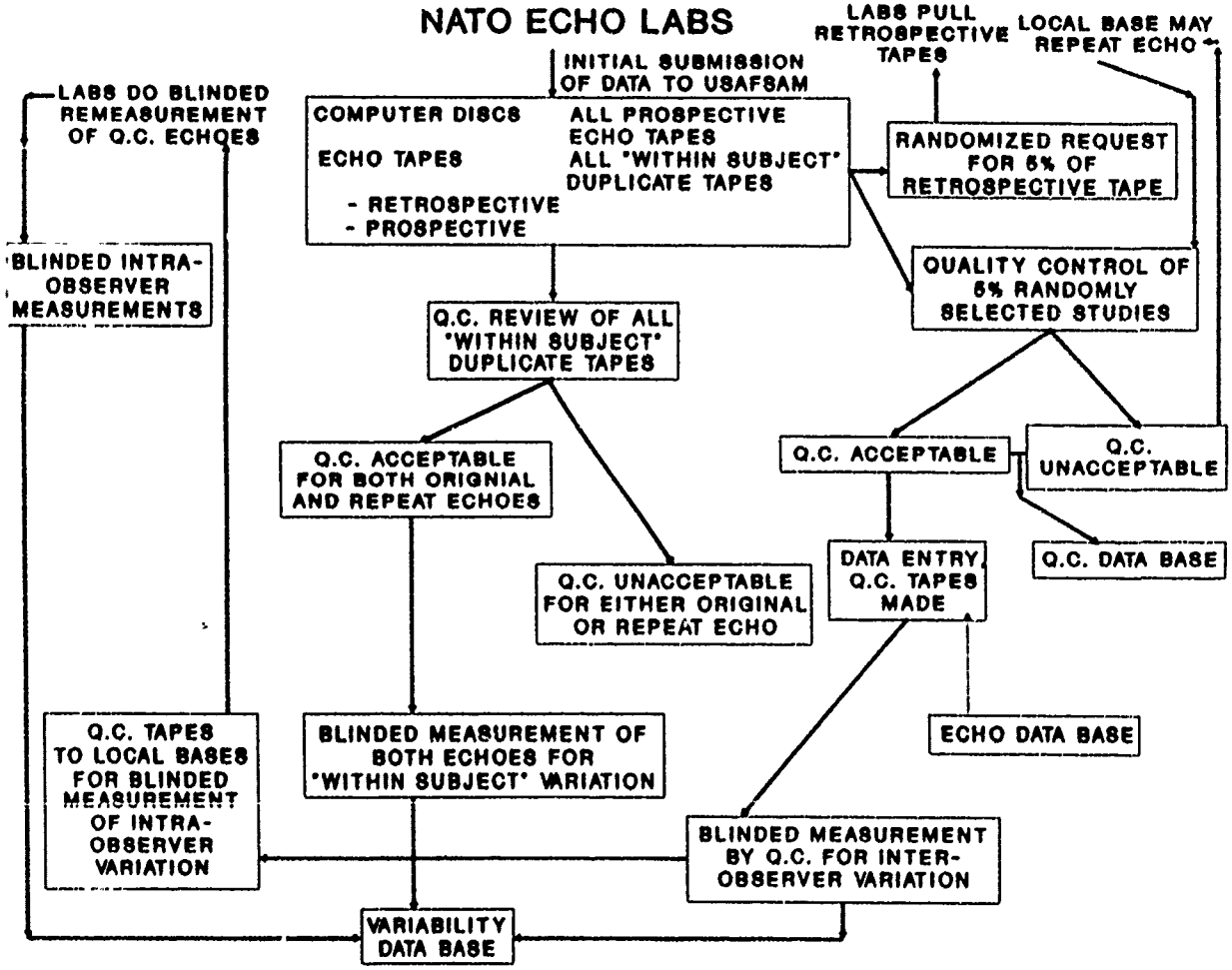


Figure 2. Echo Quality Control Flow Sheet

LIST OF NATO AIRCRAFT

VII . APPENDIXS

VII.1 - Aircrafts list :

1 :	Temoin - Non pilot	2 :	A 3
3 :	A 4	4 :	A 5
5 :	A 6	6 :	A 7
7 :	A 10	8 :	Alizé
9 :	Alpha Jet	10 :	AMX
11 :	Andover	12 :	AT 37
13 :	Avio Jet	14 :	Atlantic
15 :	Azor	16 :	B 1
17 :	B 52	18 :	B 57-66
19 :	B 707 - C 135,137 E3	20 :	B 727 - C 22
21 :	B 737 - T 43	22 :	B 747 - E 4
23 :	BA 146	24 :	BAC 111
25 :	Belfast	26 :	Buccaneer
27 :	Buffalo	28 :	C 1 - Tracker
29 :	C 5	30 :	C 9 - DC 9
31 :	C 47, 117 - Dakota	32 :	C 101
33 :	C 118 - DC 6 - DC 7	34 :	C 119
35 :	C 123	36 :	C 124
37 :	C 140 - Jet star	38 :	C 141
39 :	C 212	40 :	Cambera
41 :	Challenger	42 :	Caribou
43 :	CF 100	44 :	CL 215
45 :	CP 107	46 :	CT 39 - C 20 - C 21
47 :	DC 8	48 :	Devon Sea
49 :	Draken	50 :	E 3 - Hawkeye
51 :	Etendard 4	52 :	F 4 Phantom
53 :	F 5 Tiger T 38	54 :	F 8 Crusader
55 :	F 14	56 :	F 15
57 :	F 16	58 :	F 18
59 :	F 84	60 :	F 86
61 :	F 100	62 :	F 101
63 :	F 102	64 :	F 104
65 :	F 105	66 :	F 106
67 :	F 111	68 :	Falcon 10,20,50,900
69 :	Fouga	70 :	Fouga Magister
71 :	G 91	72 :	G 222
73 :	Gnat	74 :	Harrier-Sea
75 :	Hawk	76 :	Hercules C 130
77 :	HS 125	78 :	Hunter
79 :	Jaguar	80 :	KC 97
81 :	Lightning	82 :	MB 326
83 :	MB 339	84 :	Mirage 2000
85 :	Mirage 3	86 :	Mirage 4
87 :	Mirage 5	88 :	Mirage F1
89 :	MS 760	90 :	Mystère 4
91 :	N 2501	92 :	N 262
93 :	Nimrod	94 :	P 3 - Orion
95 :	P 166	96 :	PD 808
97 :	Pembroque	98 :	S 3 - Viking - C 2A
99 :	S 211	100 :	SMB 2
101 :	Super Etendard	102 :	T 33
103 :	Tornado	104 :	Transall - C 160
105 :	Tutor	106 :	VC 10
107 :	Venom	108 :	Vulcan
109 :	Hélicoptères	110 :	Other light a/c
111 :	Other transport a/c		

AGARD ECHOCARDIOGRAPHY WORK SHEET

All data must be entered **as of the date of the echo**

1. SUBJECT FOR

Answer yes (y) or no (n)

Cross-sectional study ☐
Longitudinal study ☐
Retrospective study ☐
For the latest is the 2-D echo available ☐
is the M-Mode available ☐

2. REASON FOR STUDY (check one)

i. Specifically for AGARD study ☐
ii. Selection for flying training ☐
iii. Routine surveillance/experienced aircrew ☐
iv. Non cardiovascular aeromedical evaluation ☐
v. Duplicate study for variation data base ☐
vi. Repeat because echo of original study is unacceptable ☐

3. EXCLUSION CRITERIA Answer all the questions by yes (y) or no (n)

FOR BOTH CROSS-SECTIONAL AND LONGITUDINAL STUDIES :

3.1 Is the subject a pilot or pilot candidat ? ☐
3.2 Is the subject on cardiovascular drugs,other than lipid-lower age.? ☐
3.3 Is the subject free from clinically diagnosed pulmonary disease ? ☐
3.4 Is the subject male ? ☐
3.5 Is the echo of acceptable quality ? ☐
3.6 Is the subject over 17 or less than 56 years of age ? ☐
3.7 Was the echo done because of suspected cardiac disease ? ☐
3.8 Are the total flying hours and hours in the past 6 months known ? ☐

FOR CROSS-SECTIONAL STUDY

3.9 Does the pilot have a mixed fighter/transport flying history ? ☐
3.10 Is the pilot currently eligible for flying duties ? ☐
3.11 Are the essential echo parameters available ? ☐
3.12 Is the type I exercise history available ? ☐
3.13 Has the subject flown at all during the past 36 months ? ☐

FOR LONGITUDINAL STUDY

3.14 If initial echo, has the subject received his pilot wings ? ☐
3.15 Is a type II exercise history available ? ☐
3.16 Does the echo data include M-mode,2D,Color flow and Doppler ? ☐

4.IDENTIFICATION NUMBER ___/____/_____
(country code / alphanumeric / 5 digit identifier)

COUNTRY CODES : 01 Belgium, 02 Canada, 03 Denmark, 04 France, 05 FRG, 16 Other
06 Greece, 07 Italy, 08 Netherland, 09 Norway, 10 Portugal
11 Spain, 12 Turkey, 13 UK, 14 USA, 15 Sweden

5. COUNTRY IN WHICH STUDY WAS DONE __ (use 2 digit code from #4)

6. NATIONALITY OF PILOT __ (use 2 digit code from #4)

7. DATE OF BIRTH __/__/__ (Month/Day/Year)

IDENTIFICATION NUMBER : __ __/__ __ __ /__ __ __ __ __ __

8. TYPE OF PILOT 00 Unknown 01 Fighter 02 Bomber 03 Transport 03 Rotary wing 04 Other 05 Non pilot personal

9. MILITARY FLYING HISTORY List in chronologic order each aircraft in wich the subject has a minimum of 50 hours. Begin with the first military aircraft flown Use the appendix list of aircraft types for codes.

DATE (YEAR)		AIRCRAFT TYPE		FLIGHT
BEGIN	END	NAME	CODE	HOURS

10. TOTAL FLIGHT HOURS _____

11. FLIGHT HOURS ON HSG AIRCRAFT _____

% Air combat _____
% Air intercept _____
% Air to ground _____

12. FLYING HOURS IN SIX MONTHS PRIOR TO THIS ECHO _____

% Air combat _____
% Air intercept _____
% Air to ground _____

13. DATE OF LAST FLIGHT __ __/__ __ (Month/Year) (if #12 = 0)

14. SMOKING HISTORY Have you ever smoke ? Yes ☐ No ☐

TYPE	#PACKS/DAY	#YEARS
Cigarettes		
Cigarillos		
Cigars		
Pipe		

If ex-smoker, number of years since quitting : __ __

15. EXERCISE HISTORY (See Procedures Manual for Examples)

For TYPE I EXERCISE; fill the following box :

TYPE I	AEROBIC	ANAEROBIC
None or very little		
Light		
Moderate		
Regular/Heavy		

For TYPE II EXERCISE; fill the exercise worksheet to evaluate Kj/week over the past six months. REQUIRED for both longitudinal &cross-sectional.

IDENTIFICATION NUMBER : __ __ /__ __ __ /__ __ __ __ __

16. HEIGHT _____ (cm) **17. WEIGHT** ____ (Kg)

18. BLOOD PRESURE (mm Hg)		Seated	Supine
	systolic		
	diastolic		

19.CHOLESTEROL (mg/dl) TOTAL ____ HDL ____

20. DATE OF ECHOCARDIOGRAM __ __ /__ __ /__ __ (Month/Day/Year)

M-MODE MEASUREMENTS :

2D Directed, short axis, below mitral valve, above papillary muscles

21	Right ventricular internal dimension/diastole	(cm)	
22	Left ventricular internal dimension/diastole	(cm)	
23	Left ventricular internal dimension/systole	(cm)	
24	Septal thickness/diastole	(cm)	
25	Septal thickness/systole	(cm)	
26	Posterior wall thickness/diastole	(cm)	
27	Posterior wall thickness/systole	(cm)	
28	Aortic dimension	(cm)	
29	Left atrial dimension	(cm)	
30	Left ventricular pre-ejection time	(millisecs)	
31	Left ventricular ejection time	(millisecs)	
32	Mitral E-F slope	(mm/sec)	
33	Heart rate	(bpm)	

BIDIMENSIONAL MEASUREMENTS

Long Axis Parasternal

34	Aortic dimension	(cm)	
35	Left atrial dimension	(cm)	

Short axis, below mitral valve, above papillary muscles.

36	Right ventricular internal dimension/diastole	(cm)	
37	Left ventricular internal dimension/diastole	(cm)	
38	Left ventricular internal dimension/systole	(cm)	
39	Septal thickness/diastole	(cm)	
40	Septal thickness/systole	(cm)	
41	Posterior wall thickness/diastole	(cm)	
42	Posterior wall thickness/systole	(cm)	

Apical Four Chamber View

43	Maximum right ventricular inter. dim./diastole	(cm)	
44	Right ventricular area/diastole	(cm)	

IDENTIFICATION NUMBER : __ __ /__ __ __ /__ __ __ __ __

DOPPLER MEASUREMENTS

	AORTIC FLOW	
45	Peak velocity (m/sec)	
46	LV pre-ejec. time (msec)	
47	LV ejection time (msec)	
48	Acceleration time (msec)	
49	Insufficiency (one option)	

None | Minimal | Mild
Moderate | Severe

	PULMONARY FLOW	
50	Peak velocity (m/sec)	
51	RV pre-ejec. time (msec)	
52	RV ejection time (msec)	
53	Acceleration time (msec)	
54	Insufficiency (one option)	

None | Minimal | Mild
Moderate | Severe

	MITRAL VALVE	
55	Peak velocity E (m/sec)	
56	Peak velocity A (m/sec)	
57	Mitral regurgitation (one option)	

None | Minimal(just det.) | Mild(<20%)
Moderate (20-40%) | Severe (>40%)

	TRICUSPIDE VALVE	
58	Peak velocity E (m/sec)	
59	Peak velocity A (m/sec)	
60	Tricuspid regurgitation (one opt)	

None | Minimal(just det.) | Mild(<20%)
Moderate (20-40%) | Severe (>40%)

QUALITATIVE ECHOCARDIOGRAPHIC ASSESSMENT

61 - Are there any other echocardiographic findings ? Yes ☐ No ☐

If yes, check all positive findings.

VALVULAR

MITRAL VALVE

Stenotic	62	Yes	No			
	AL			PL		
Thickened	63	Yes	No	68	Yes	No
Redundant	64	Yes	No	69	Yes	No
Prolapse	65	Yes	No	70	Yes	No
Flail	66	Yes	No	71	Yes	No
Fluttering	67	Yes	No	72	Yes	No

AL = Anterior Leaflet
PL = Posterior Leaflet

TRICUSPID VALVE

Stenotic	73	Yes	No
Thickened	74	Yes	No
Redundant	75	Yes	No
Prolapse	76	Yes	No
Flail	77	Yes	No

PULMONARY VALVE

Bicuspid	78	Yes	No

AORTIC VALVE

Bicuspid	79	Yes	No
Thickened	80	Yes	No
Stenotic	81	Yes	No
Calcified	82	Yes	No

IDENTIFICATION NUMBER : ___/__ ___ / _____

WALLS

83	Motion abnormality	Yes No
84	Assimetric septal hypertrophy (Septal/posterior wall ratio>1.3)	Yes No

SEGMENTS (If #83 = YES)

83.1 - Anterior	Normal Hypokinetic	Dyskinetic Akinetic
83.2 - Lateral	Normal Hypokinetic	Dyskinetic Akinetic
83.3 - Posterior	Normal Hypokinetic	Dyskinetic Akinetic
83.4 - Median	Normal Hypokinetic	Dyskinetic Akinetic
83.5 - Anterior	Normal Hypokinetic	Dyskinetic Akinetic
83.6 - Lateral	Normal Hypokinetic	Dyskinetic Akinetic
83.7 - Posterior	Normal Hypokinetic	Dyskinetic Akinetic
83.8 - Median	Normal Hypokinetic	Dyskinetic Akinetic
83.9 - Apex	Normal Hypokinetic	Dyskinetic Akinetic

OTHER

Myxoma	85	Yes	No
Focal hypertropy	86	Yes	No
Septal paradox	87	Yes	No
ASD	88	Yes	No
VSD	89	Yes	No
Thrombus	90	Yes	No

91. Others (5 letters) :

TYPE II EXERCISE QUESTIONNAIRE PART I

Identification number : _____
Country code : ____
Birth date : ___ / ___ / _____

ACTIVITY	#Hours per Day	#Days per week	#Weeks past last 6 months
Aerobics			
Archery			
Badminton			
Basketball			
Bowling			
Boxing : In ring			
Boxing : sparring			
Canoeing : competition			
Canoeing : leisure			
Circuit-training			
Climbing hills : with 20 kg			
Climbing hills : with 10 Kg			
Climbing hills : with 5 Kg			
Climbing hills : with no load			
Cricket : batting			
Cricket : bowling			
Croquet			
Cycling : competition			
Cycling : leisure 15 km:h			
Cycling : leisure 8 km/h			
Field hockey			
American football			
Golf			
Gymnastic			
Horse : race, gallop			
Horse : training			
Horse : Walk			
Horse : Trot			
Ice hockey			
Judo			
Marching, rapid			
Musculation : Circuit (Men)			
Musculation : Circuit (Women)			

TYPE II EXERCISE QUESTIONNAIRE PART II

Identification number : _____
Country code : ____
Birth date : ___ / ___ / _____

ACTIVITY	#Hours per Day	#Days per week	#Weeks past last 6 months
Running, cross country			
Running, on the level, 5'30 per mile			
Running, on the level, 6' per mile			
Running, on the level, 7' per mile			
Running, on the level, 8' per mile			
Running, on the level, 9' per mile			
Running, on the level, 11'30 per mile			
Scuba diving, moderately active			
Scuba diving, very active			
Skiing, hard snow, on hill, maximum speed			
Skiing, hard snow, on the flat, walking			
Skiing, on the flat, moderate speed			
Skiing, powdered snow, leisure (Men)			
Skiing, powdered snow, leisure (Women)			
Snow shoeing, powdered snow			
Soccer, European football			
Squash			
Swimming : Breast stroke			
Swimming : Crawl, leisure			
Swimming : Crawl, fast			
Swimming : Backstroke			
Swimming : Sidestroke			
Swimming : Treading, normal			
Swimming : Treading, fast			
Table tennis			
Tennis			
Volleyball			
Walking : Plowed field			
Walking : Fields & hillsides			
Walking : Asphalt road			
Walking : Grass track			
Weight training			

Technical Section

TECHNICAL SECTION

INTRODUCTION

Echocardiography is a contemporary method of cardiac investigation; the relative simplicity of the technique must not obscure the fact that echocardiography, whatever the equipment or the circumstances, remains crucially dependent upon the experience and expertise of the operator. The following technical recommendations are designed to minimize between-centre variability; the measurement protocols are mostly those of the American Society of Echocardiography (ASE). Additional standards have been devised by AMP WG 13 to meet the specific requirements of the proposed study. Illustrations are labeled by number and by corresponding worksheet (WS) number. This AGARD/AMP Technical Section was designed to be used in conjunction with, and referenced with, the AGARD/AMP Echocardiographic Worksheet.

PATIENT POSITION

Recumbent, full length with head slightly raised. The arterial blood pressure used for wall stress calculation will be obtained with the patient recumbent and relaxed.

EQUIPMENT SETTINGS

Minimum gain consistent with visualizing all structures to be studied, without excessive brightness. Depth compensation of gain: adjusted so that both near and distant structures are visible and the endocardial boundaries are clear. Special attention will be given to the anterior wall of the right ventricle to avoid "echo saturation" at this level and to define boundaries clearly. (This is one of the essential conditions for obtaining true measurements of the right ventricle.) Cardiac image should be sufficiently enlarged to take up essentially the whole screen; though a small picture may make measurements between surfaces seem easier, in fact, the loss of (finer) structures increases measurement errors.

STANDARD PROTOCOL FOR THE ECHO EXAMINATION

Since extra videotape will be required for quality control, please record extra footage prior to freeze-frame analysis, caliper position and measurement projection. M-mode recording and/or hard copies are required.

For the longitudinal study, the heart must be examined in all standard projections to detect any cardiac disorder that would be a bar to inclusion in the study.

M-MODE MEASUREMENTS

The necessary M-mode measurements are made using standard echo windows. For the cross-sectional prospective data as well as the longitudinal study, two-dimensional guided M-modes should be performed, such that the M-mode image is obtained while scanning in the parasternal short-axis view.

- Right Ventricular Internal Dimension Diastole (Fig. 1, WS #21)

This measurement is made by the parasternal short-axis window, below the mitral valve, at the apices of the left ventricular papillary muscles. End-diastole is marked by the onset of the ECG Q wave. The right ventricular dimension in end-diastole is measured from the posterior margin of the right ventricular anterior wall to the superior margin of the interventricular septum.

Figure 1, WS #21

- Left Ventricular Internal Dimension Diastole/Systole (Fig. 2, WS #22, #23)

These measurements are made by the parasternal short-axis window, below the mitral valve, at the apices of the left ventricular papillary muscles. Systole is defined by the maximum thickening of the left ventricular posterior wall. End-diastole is marked by the onset of the ECG Q wave.

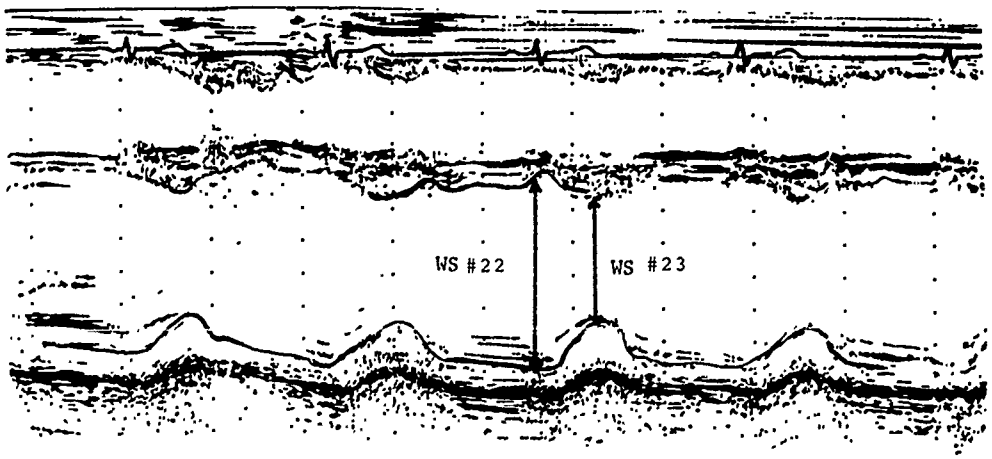


Figure 2, WS #22, #23

- Septal Thickness Diastole/Systole, Posterior Wall Thickness Diastole/Systole (Fig. 3, WS #24, #25, #26, #27)

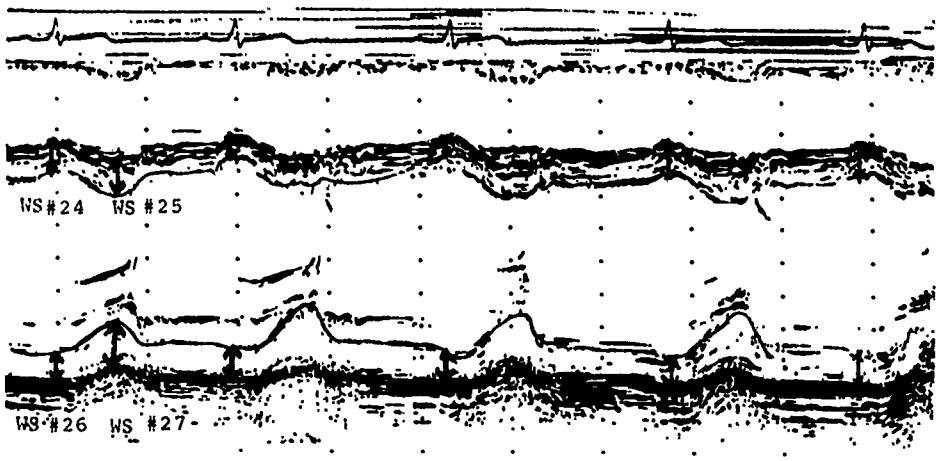


Figure 3, WS #24, #25, #26, #27

- Aortic Dimensions (Fig. 4, WS #28)

Aortic dimensions are measured at the onset of the ECG Q wave. Measurements are taken from the superior aspect of the aortic anterior wall to the superior surface of the aortic posterior wall (i.e., leading edge to leading edge).

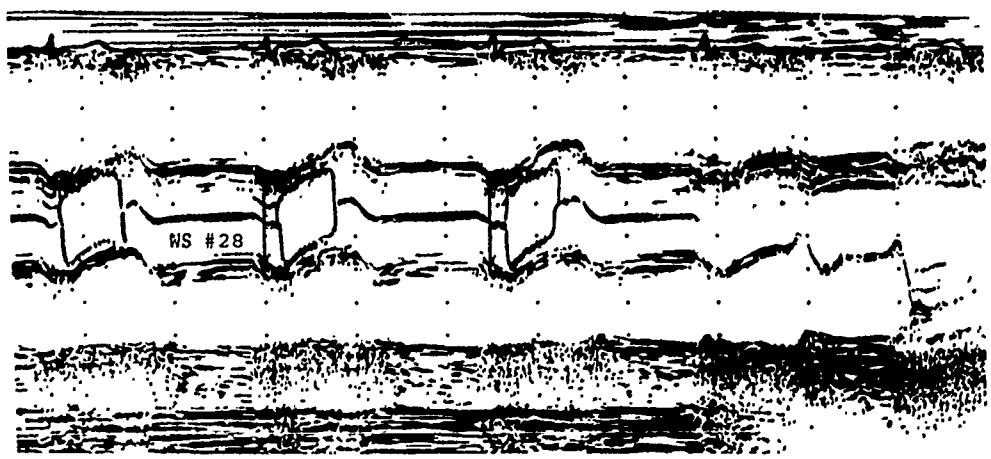


Figure 4, WS #28

- Left Atrial Dimension (Fig. 5, WS #29)

Left atrial dimensions are measured at the widest dimension at the end of ventricular systole. Measurements are obtained from the superior surface of the aortic posterior wall to the superior surface of the posterior wall of the left atrium. The measurement level corresponds with the closure point of the aortic cusps on the M-mode tracing. Special attention should be given to not including a pulmonary vein or descending aorta in the left atrial measurement.

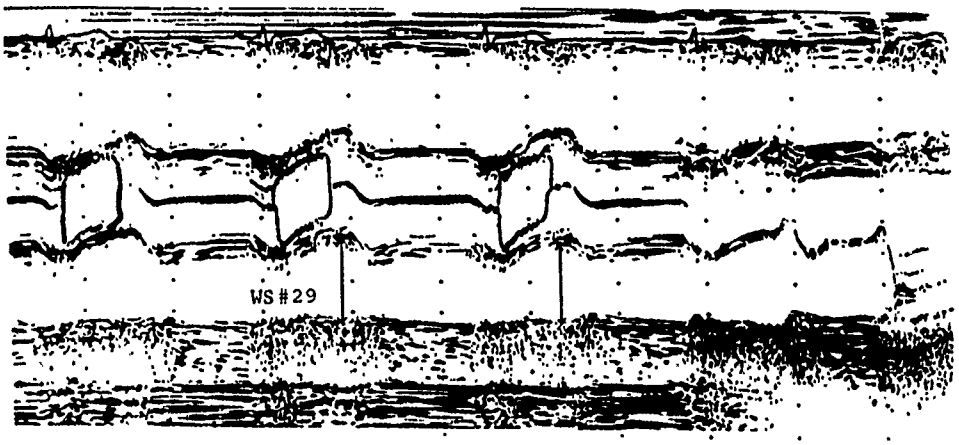


Figure 5, WS #29

- M-mode Systolic Time Intervals (Fig. 6, WS #30, #31)

These intervals require a clearly defined Q wave.

Pre-ejection period: The left ventricular pre-ejection period starts at the onset of the ECG Q wave and ends at the onset of the aortic valve opening.

Ejection period: The left ventricular ejection period starts at the onset of the aortic valve opening (opening box) and ends at valve closure.

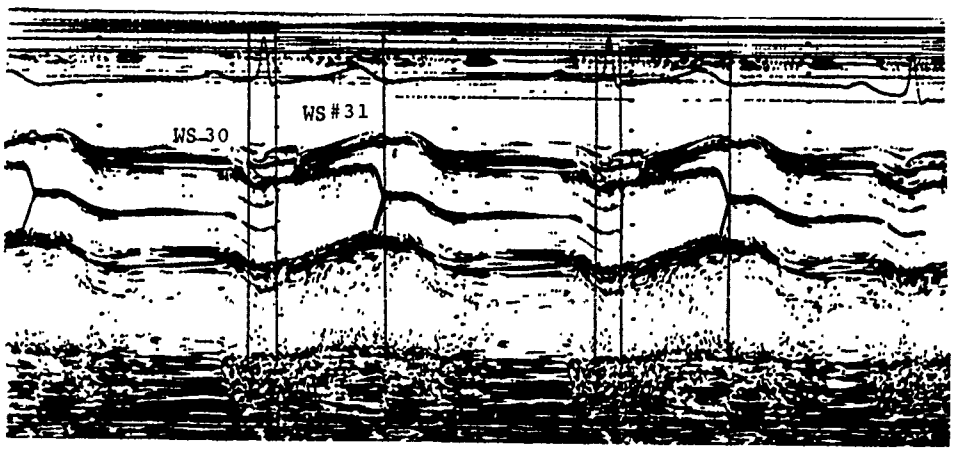


Figure 6, WS #30, #31

- E-F Slope - Mitral Valve (Fig. 7, WS #32)

Please note, attention needs to be taken that the F point be defined as the lowest point on the slope.

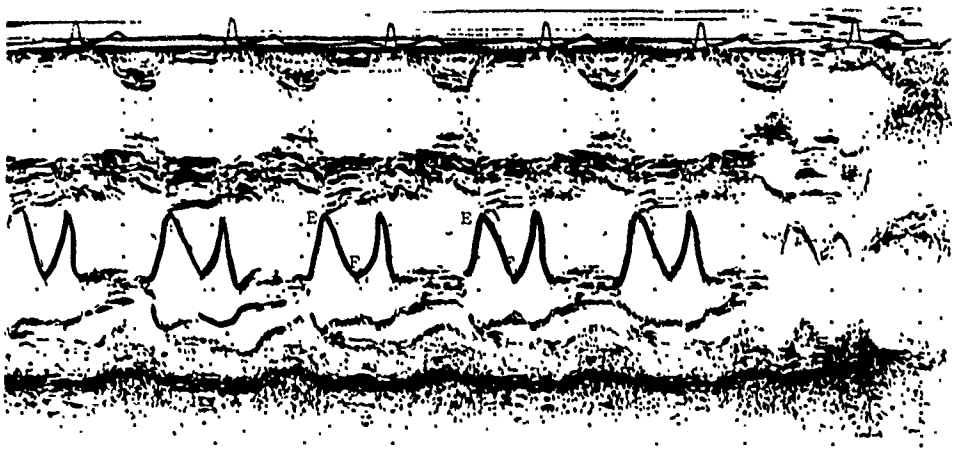


Figure 7, WS #32

TWO-DIMENSIONAL (BIDIRECTIONAL) MEASUREMENTS

In order to obtain appropriate, proper measurements, the following two-dimensional (2-D) views must be performed.

- Parasternal Long-Axis View

- Parasternal Short-Axis View, 3 levels (Fig. 8): At the base where the aortic root and aortic valve can be visualized, at the level of the mitral valve, and within the left ventricular chamber at the apices of the papillary muscles.

- Apical 4-Chamber View

- Apical 2-Chamber View

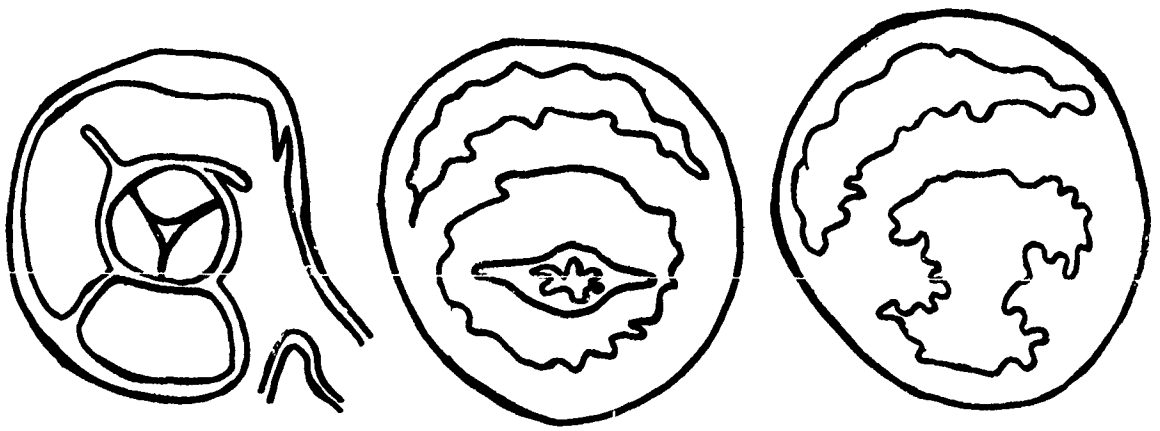


Figure 8

PARASTERNAL LONG-AXIS VIEW

- Aortic Dimension (Fig. 9, WS #34)

The aorta is measured in the anteroposterior diameter at the level of the sinuses of Valsalva. This measurement is taken at end-diastole, onset of the ECG Q wave.

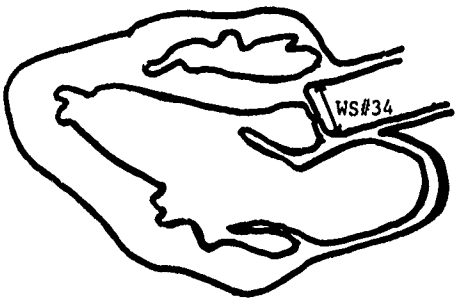


Figure 9, WS #34

- Left Atrial Dimension (Fig. 10, WS #35)

Anteroposterior dimension of the chamber from the superior surface of the aortic posterior wall to the superior surface of the left atrium. This measurement is taken at the end of ventricular systole.

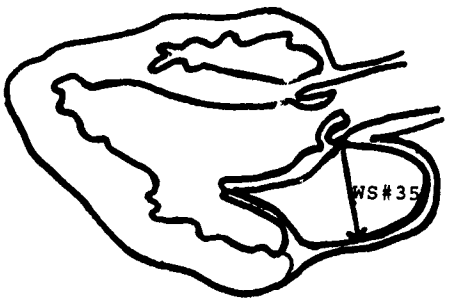


Figure 10, WS #35

PARASTERNAL SHORT-AXIS VIEW (Below the mitral valve, above or at the apices of the papillary muscles)

- Right Ventricular Internal Dimension Diastole (Fig. 11, WS #36)

Right ventricular dimension is measured from the posterior margin of the right ventricular anterior free wall to the superior margin of the intraventricular septum. End-diastole is defined as the beginning of the QRS complex.

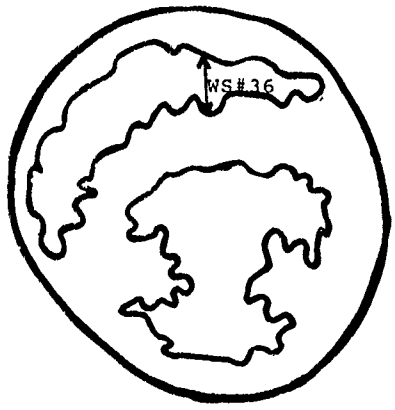


Figure 11, WS #36

- Left Ventricular Internal Dimension Diastole/Systole (Fig. 12, WS #37, #38)

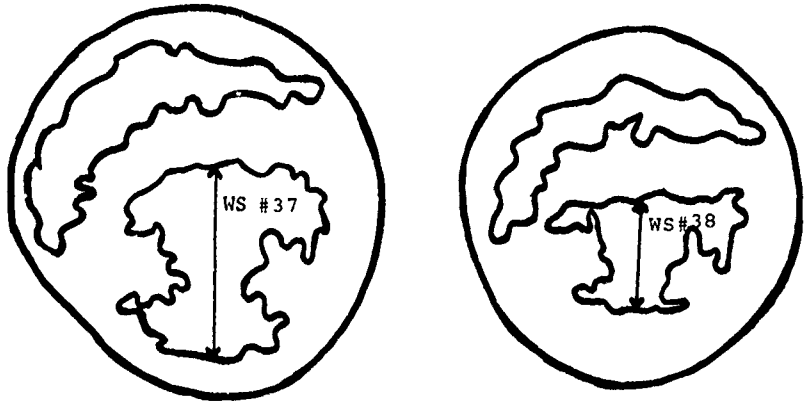


Figure 12, WS #37, #38

- Septal Thickness Diastole/Systole, Posterior Wall Thickness Diastole/Systole (Fig. 13, WS #39, #40, #41, #42)

APICAL 4-CHAMBER VIEW

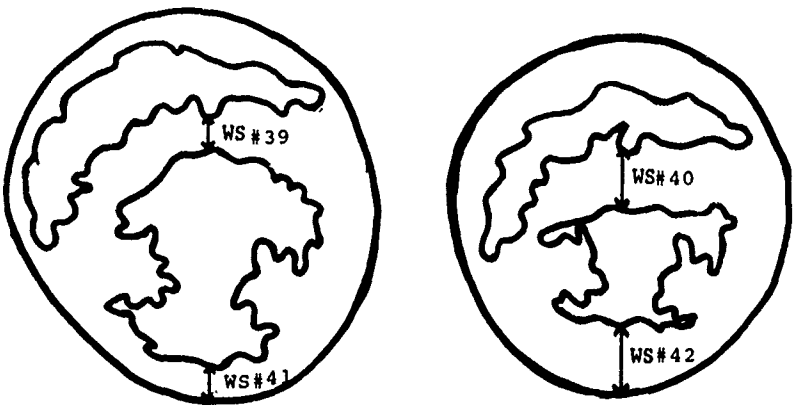


Figure 13, WS #39, #40, #41, #42

- Maximal Right Ventricular Internal Dimensions Diastole (Fig. 14, WS #43)

This measurement is performed at end-diastole, the onset of the ECG Q wave. Measurement is made from maximal medial to lateral measurement in the right ventricle.

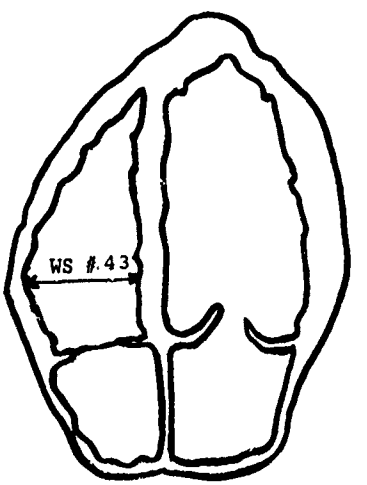


Figure 14, WS #43

- Right Ventricular Area Diastole (Fig. 15, WS #44)

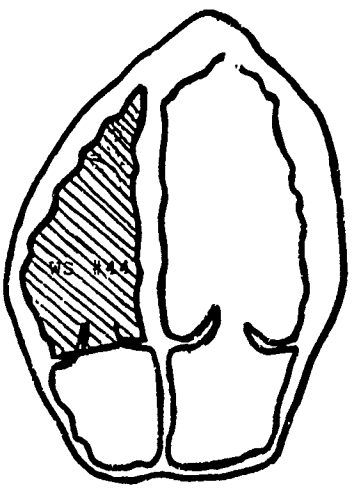


Figure 15, WS #44

DOPPLER MEASUREMENTS

Doppler measurements are made utilizing three modalities:

Pulsed-wave Doppler (PW)

Continuous-wave Doppler (CW)

Color-flow imaging (CFI)

When measurements of velocity are to be obtained, we recommend that the beam be aligned as parallel as possible to the direction of blood flow. When measuring the left ventricular outflow tract and pulmonary artery velocity, the sample volume for pulsed-wave Doppler measurement should be positioned in the plane of the valve ring. Special attention should be given to recording three consecutive heart beats with the maximal velocity obtained recorded. These velocities should reflect the appropriate spectral envelope. The recording of the Doppler studies should be done at 100 mm/sec so appropriate systolic time intervals can be measured. The study of systolic time intervals in the Doppler mode requires a precisely defined ECG Q wave. The following Doppler measurements are required.

AORTIC FLOW

Aortic flow is measured with CW Doppler, most typically with 2-D guidance in the apical 5-chamber view. Aortic flow can also be measured from the suprasternal notch or right parasternal border (Fig. 16).

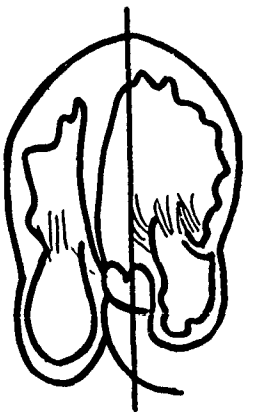


Figure 16

- Peak Aortic Velocity (Fig. 17, WS #45) CW Doppler measurement

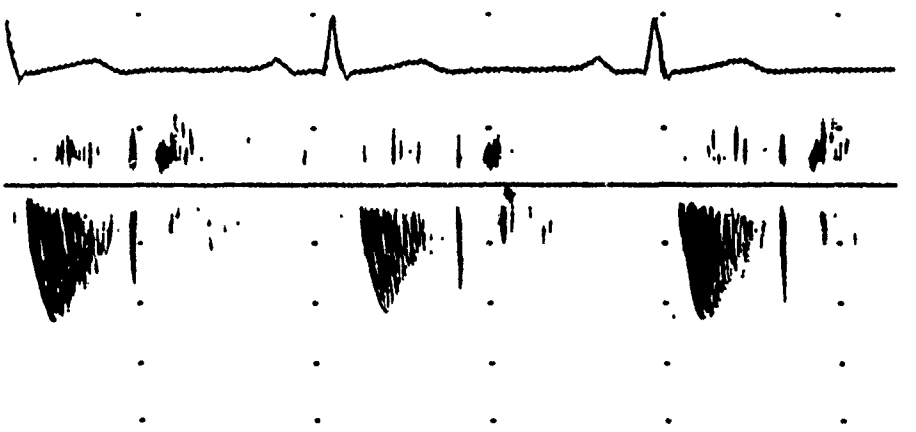


Figure 17, WS #45

- Left Ventricular Pre-Ejection Time, Left Ventricular Ejection Time, Left Ventricular Acceleration Time (Fig. 18, WS #46, #47, #48)

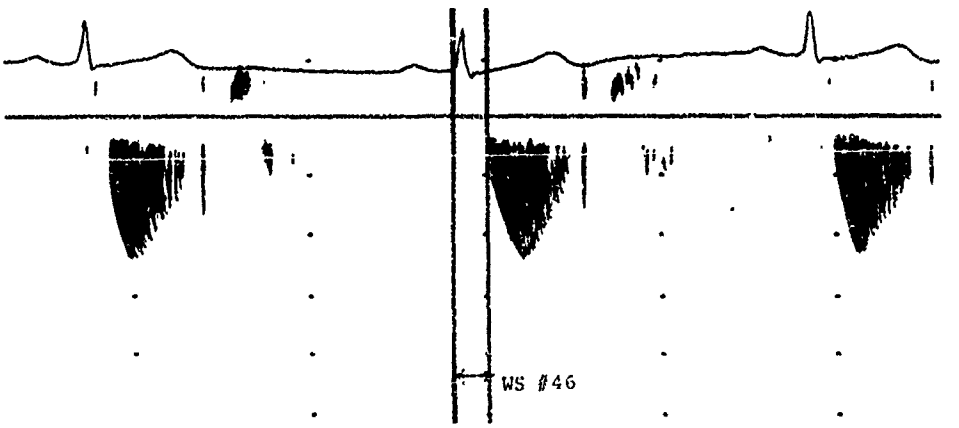


Figure 18, WS #46

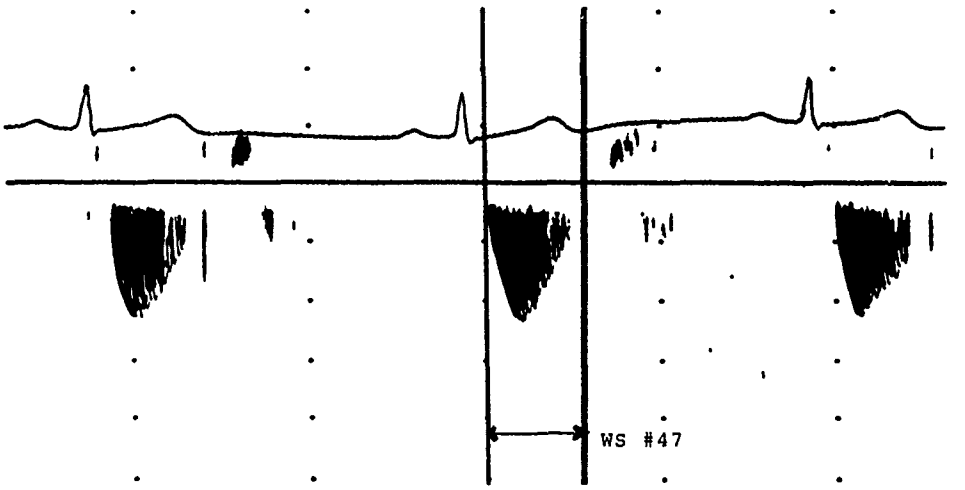


Figure 18, WS #47

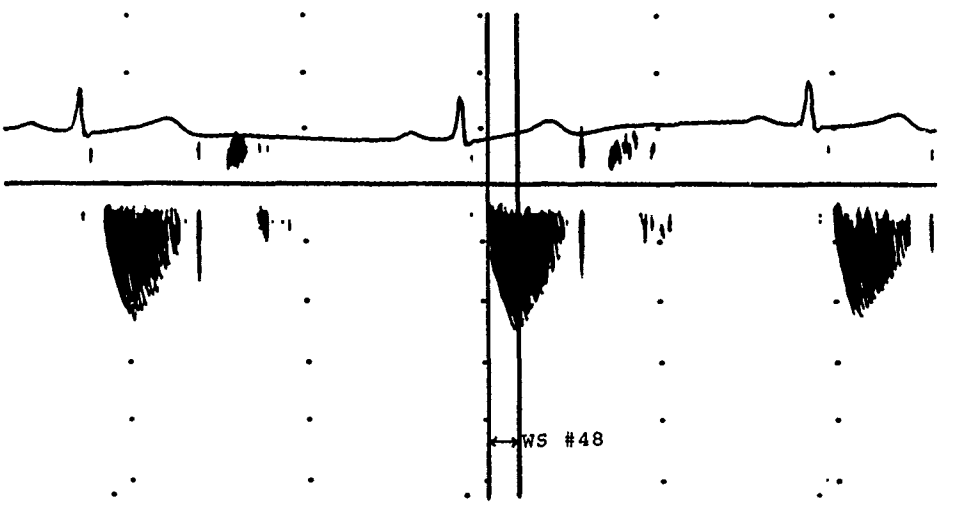


Figure 18, WS #48

- Aortic Insufficiency (WS #49)

Aortic insufficiency should be graded by CFI utilizing the apical 5-chamber view, parasternal long-axis view, and apical 2-chamber view. Aortic insufficiency shall be graded as minimal, mild, moderate, or severe. Minimal aortic insufficiency is defined when the insufficiency jet is seen just behind the aortic valve. Mild aortic insufficiency is defined by the presence of a jet extending back across the aortic valve but not past the tips of the mitral leaflets. The width of the aortic insufficiency jet should be less than 25% of the left ventricular outflow tract. Moderate aortic insufficiency is defined as an insufficiency jet extending past the tips of the mitral valve but encompassing less than 50% of the left ventricular cavity volume. The width of this aortic insufficiency jet should be greater than 25% but less than 50% of the left ventricular outflow tract. Severe aortic insufficiency is defined when the jet reaches back and encompasses greater than 50% of the left ventricular cavity volume, and when the jet takes greater than 50% of the left ventricular outflow tract in width.

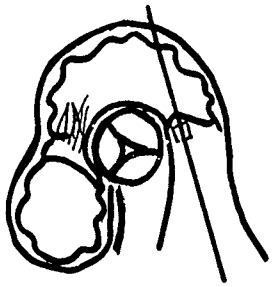


Figure 19, WS #50

- Peak velocity (Fig. 20, WS #50)

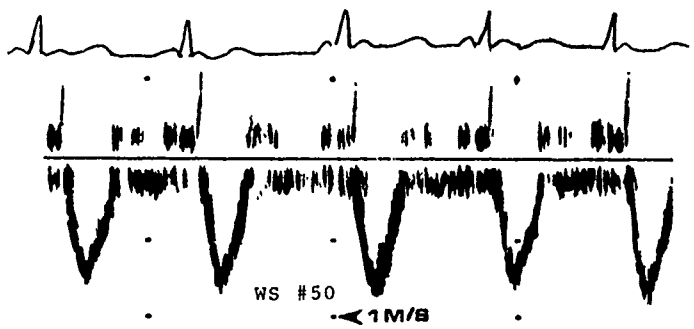


Figure 20, WS #50

- Right Ventricular Pre-Ejection Time, Right Ventricular Ejection Time, Right Ventricular Acceleration Time (Fig. 21, WS #51, #52, #53)

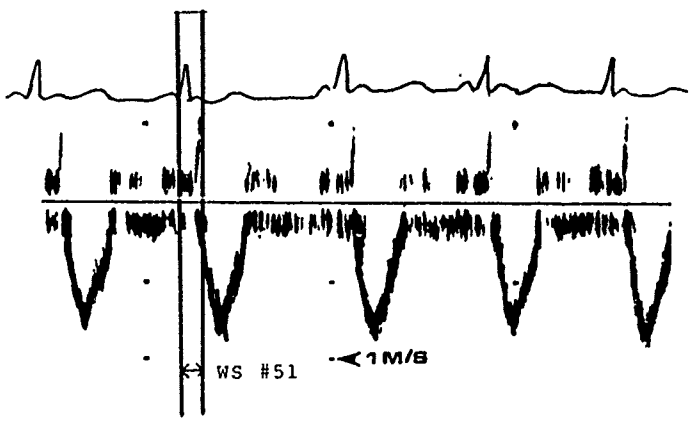


Figure 21, WS #51

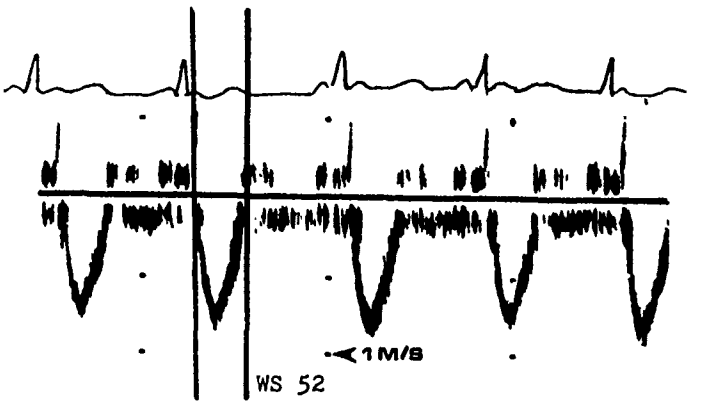


Figure 21, WS #52

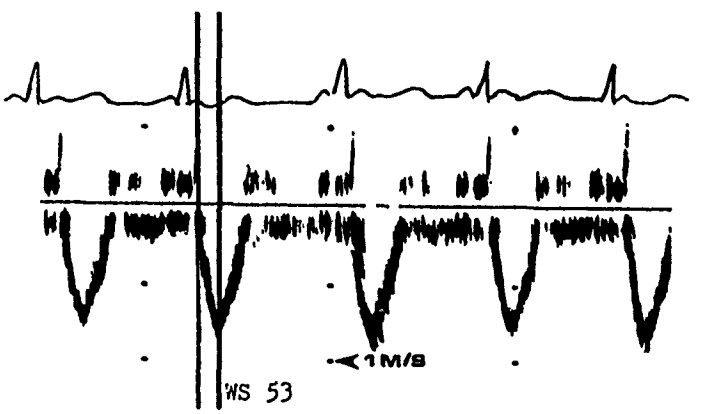


Figure 21, WS #53

- Pulmonary insufficiency shall be noted and graded wi. ı there is a jet illustrated by CFI extending back from the pulmonic valve into the right ventricular outflow tract. If this is not noted, then there is no pulmonary insufficiency. Pulmonary insufficiency shall be graded as minimal, mild, moderate, or severe. Minimal pulmonary insufficiency is defined as a small jet or "candle flame"-appearing image flowing back into the right ventricular outflow tract but involving a minimal area as compared to the outflow tract area. Mild pulmonary insufficiency is defined as a well-defined jet, though not reaching 25% of the a.ea of the outflow tract. Moderate pulmonary insufficiency is defined as a jet encompassing 25%-50% of the right ventricular outflow tract area. Severe pulmonary insufficiency is defined as a jet encompassing greater than 50% of the right ventricular outflow tract area.

MITRAL VALVE

- Peak Velocities for the E and A Point (Fig. 22, WS #55, #56)

E and A point velocities are measured with PW Doppler with the sample volume placed at the tips of the mitral leaflets during diastole. It is of utmost importance that the sample volume be placed right at the mitral leaflet tips, in diastole, in the apical 4-chamber view.

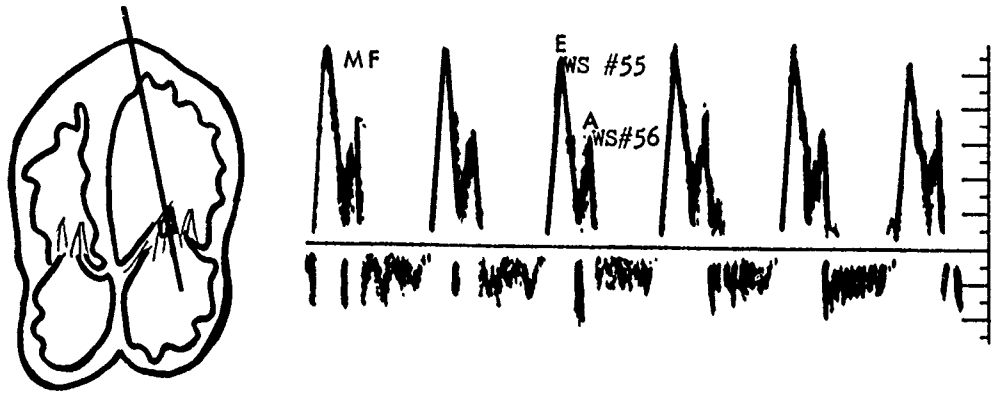


Figure 22, WS #55, #56

- Mitral Regurgitation (WS #57)

Mitral regurgitation should be graded using CFI. Standard views for grading mitral regurgitation are the parasternal long-axis view, apical 4-chamber view, and apical 2-chamber view. Minimal mitral regurgitation is noted when the regurgitant jet just crosses the mitral valve during systole. Mild mitral regurgitation is defined as a regurgitant jet encompassing 20%-40% of the left atrial area. Severe mitral regurgitation is defined as a regurgitant jet which encompasses greater than 40% of the left atrial area.

TRICUSPID VALVE

- Peak Velocity E, Peak Velocity A (Fig. 23, WS #58, #59)

The peak E and A point velocities for the tricuspid valve shall be measured in the apical 4-chamber view with PW Doppler. The PW sample volume shall be placed at the tip of the tricuspid leaflets during diastole. Special attention must be given to the placement of the sample PW Doppler sample volume in order to obtain the correct right ventricular inflow tract E and A point velocities.

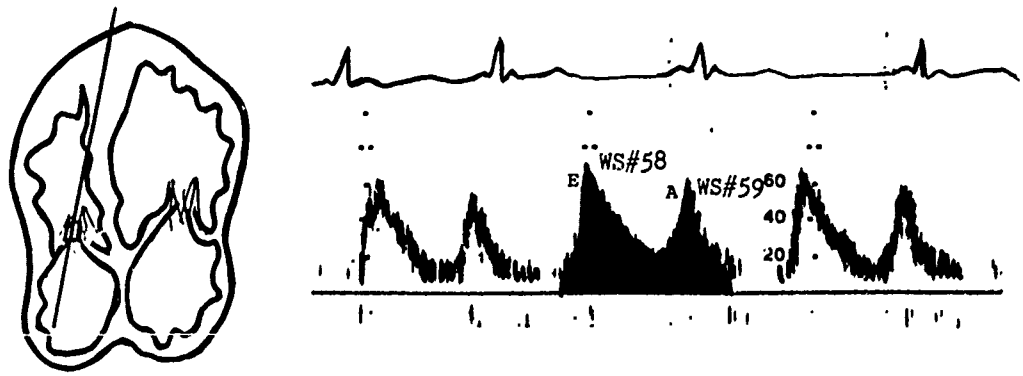


Figure 23, WS #58, #59

- Tricuspid Regurgitation (WS #60)

The definitions of severity for tricuspid regurgitation are identical to the definitions of severity for mitral regurgitation. Please refer to that explanation above.

QUALITATIVE ECHOCARDIOGRAPHIC ASSESSMENT

- Mitral Valve Prolapse (Fig. 24, WS #65, #70)

The echocardiographic diagnosis of mitral valve prolapse (MVP) will be made by bi-directional criteria when both leaflets together, either leaflet alone, or parts of either leaflet cross the annular plane during systole, when viewed in the parasternal long-axis view. M-mode criteria require that 2 mm of late systolic hammocking be present; 3 mm of pansystolic hammocking is diagnostic of MVP when 2-D confirmation (as described) is made. If 2-D criteria for the diagnosis of MVP are not met, M-mode pan-systolic hammocking alone is not sufficient to diagnosis MVP.

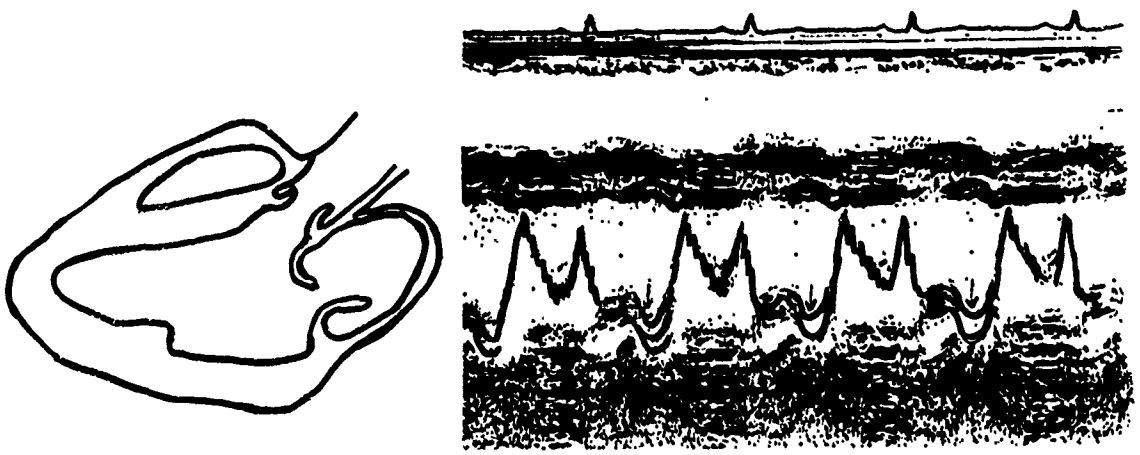


Figure 24, WS #65, #70

- Walls Hypokinetic Segment, Dyskinetic Segment (Fig. 25, WS #83, #84)

If a wall motion abnormality is present, please refer to the appropriate wall segment and designate this wall segment appropriately.

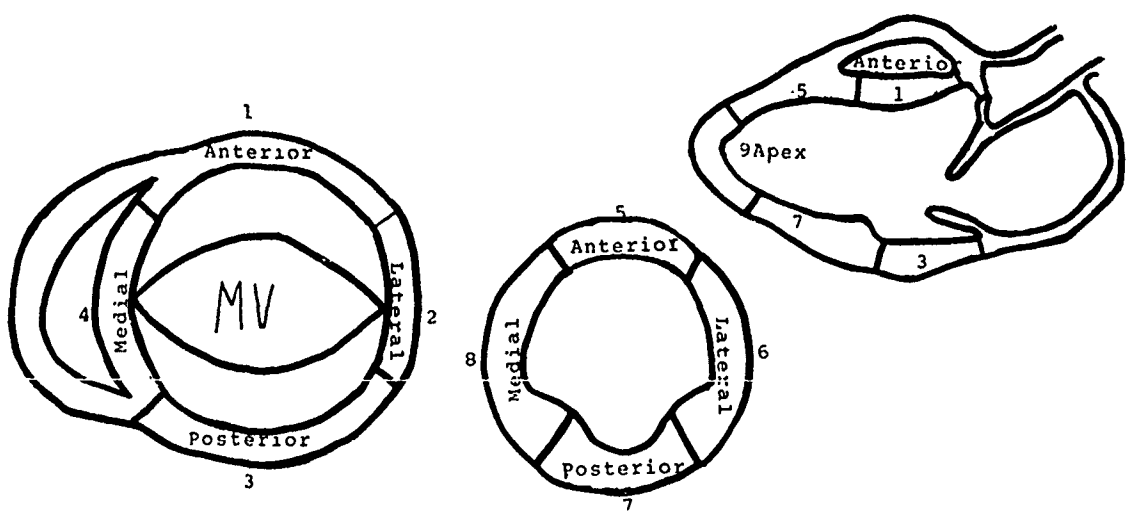
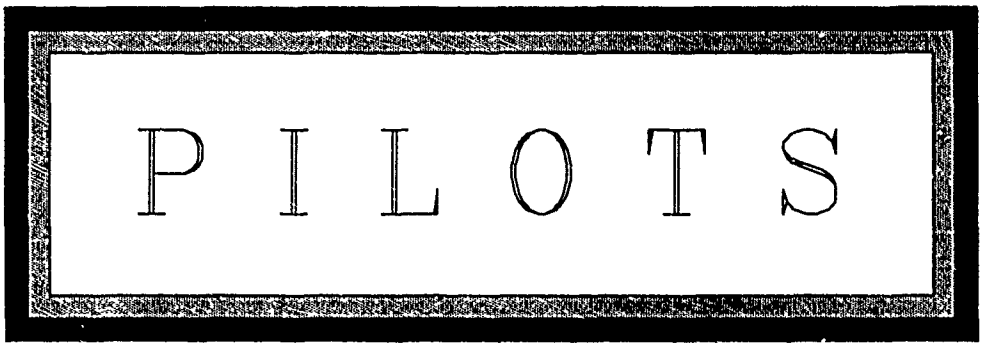


Figure 25, WS #83, #84

Acquisition Software and Operating Instructions Section



PILOTS ECHOCARDIOGRAPHIC DATA

ACQUISITION SOFTWARE

Centre d'Etudes et de Recherches de Médecine Aérospatiale

Laboratoire Central de Biologie Aérospatiale

Division de Biomécanique

Base d'essai en vol

91220 - BRETIGNY SUR ORGE

Operating instructions

FOREWORD

"PILOTS" is a system to collect echocardiographic cards for subjects and store them on a hard disk.

This software was developed in order to suppress acquisition errors for variables card and to carry out a direct statistical study of cards through SAS software (*). Each numerical variable entered is compared to the minima and maxima found in nature as well as with normal minima and maxima for this variable. Therefore, the user cannot enter a value out of these limits and a window will appear asking to confirm the input of abnormal value.

Summary description :

- With "PILOTS" the card for each pilot can be inputed, with a test of variables inputed against validity limits. Several variables are calculated from the one that was inputed.

- "PILOTS" provides classical functions for file management :
  - Suppressing card,
  - Correcting card,
  - Printing cards.

- With "PILOTS"' an ASCII file can also be created from the entered cards in order to use this file with another software (**EXCEL or LOTUS 123** (*) for example).

- "PILOTS" is written in three languages : French, English and Spanish. At any moment, the user can go from one language to other according to his wishes. It is also fully retranslatable using TRADUIT program and it can therefore be used in any language.

- "PILOTS" has been made as ergonomic as possible using known principles : Pop-up menus, Warning windows, Mouse if it exists, Help messages accessible at every moment.

- With "PILOTS" cards entered can be transfered on floppy disk so that each Department can send Brooks USAFB data for processing.

- (*) SAS , EXCEL et LOTUS 123 are registred trade mark by SAS Institute, Microsoft et LOTUS.

TABLE OF CONTENTS

I . SOFTWARE INSTALLATION

Software is delivered in the form of 5'1/4 or 3'1/2 floppy disk at the IBM PC format. This floppy disk contains all the starting files of the software as well an installation program.

To install the software, all you have to do is to insert the floppy disk into drive A: and to type :

A:INSTALL (Enter)

In this instruction manual for users, (Enter) represents the key "Entrée" or "Enter" or (↵) .

The software is then installed on a hard disk in a repertory which will be created and which is called "C:\PILOTS" in case no other name is specified.

The installation program first asks the user to give his prefered language : French, English or Spanish by pressing one of three keys F, E or S.

The third language which is Spanish can be totally redefined. You can therefore use "PILOTS" in Italian if you wish ! You must then choose the INSTALL option "S" : (Spanish or language of the third type). You must then type the name of this language. Once finished, INSTALL will start the translating program "TRADUIT" which will translate all messages and base screens of PILOTS. (Refer to chapter VI.5 for more details on "TRADUIT".

Please notice that most messages in spanish are translated **but not all**. For Spanish it is therefore necessary to check and correct **all messages** if necessary !

You must enter the starting parameters for the software :
- the name of the repertory must be entered if "C:\PILOTS" is not convenient. If it is OK, please press (Enter) key.
- the format type for dates : dates can be coded by the format "day-month-year" or "month-day-year" (this characteristic will be input after each language change).
- the type of your printer : to reproduce the tableaux, your printer must be full compatible with the extended character set of the IBM PC (ASCII code > 127 cf appendix). If your printer is nct compatible, the software will draw the tableaux with the characters "_" et "|".

It creates the destination repertory if necessary and copies the various files making up the software :

- PRESENTE.EXE :	Presentation of software.
- PILOTS.EXE :	Executable file of "PILOTS" software.
- PILOTS.HLP :	File containing help messages.
- PILOTS.LN3, PILOTS.ECR :	Files containing messages and base screens for the third language.

Then the configuration file is created containing basic configuration data of software (PILOTS.CON)(departure language, screen attributes, etc...).

Finally, it creates in the transparent repertory of the hard disk (PATH) if it exists, if not in repertory "C:\", a batch file PILOTS.BAT which can be used to start the software from any repertory if the transparent repertory exists.

To start the software the user enters :
PILOTS (Enter).

The software uses pop-up menus, windows that are displayed with a certain color on the screen. This color is currently called ATTRIBUTE. Attributes for displays which are defined can be used with a color monitor. If these attributes are not good for you, especially if you have a black & white monitor, you can entirely redefine them. All you have to do is to select option "Screen attributes" in "Configuration" menu. These redefined attributes will remained redefined as long as you don't change them again.

Minimum configuration for PILOTS :
- Memory : 250 Kbyte,
- 1 hard disk with a minimum of 376 Kbytes available and 862 bytes per entered card,
- 1 floppy disk drive 5'1/4 or 3'1/2.

II . PRESENTATION :

The starting screen of "PILOTS" has on its first line a menu bar reminding that one of the 3 principal menus have to be selected : File, Output, Configuration. The access mode of the principal functions are reminded as well as the number of cards already entered into the file. Figure 1 shows the initial screen as well as the various redefinable attributes.

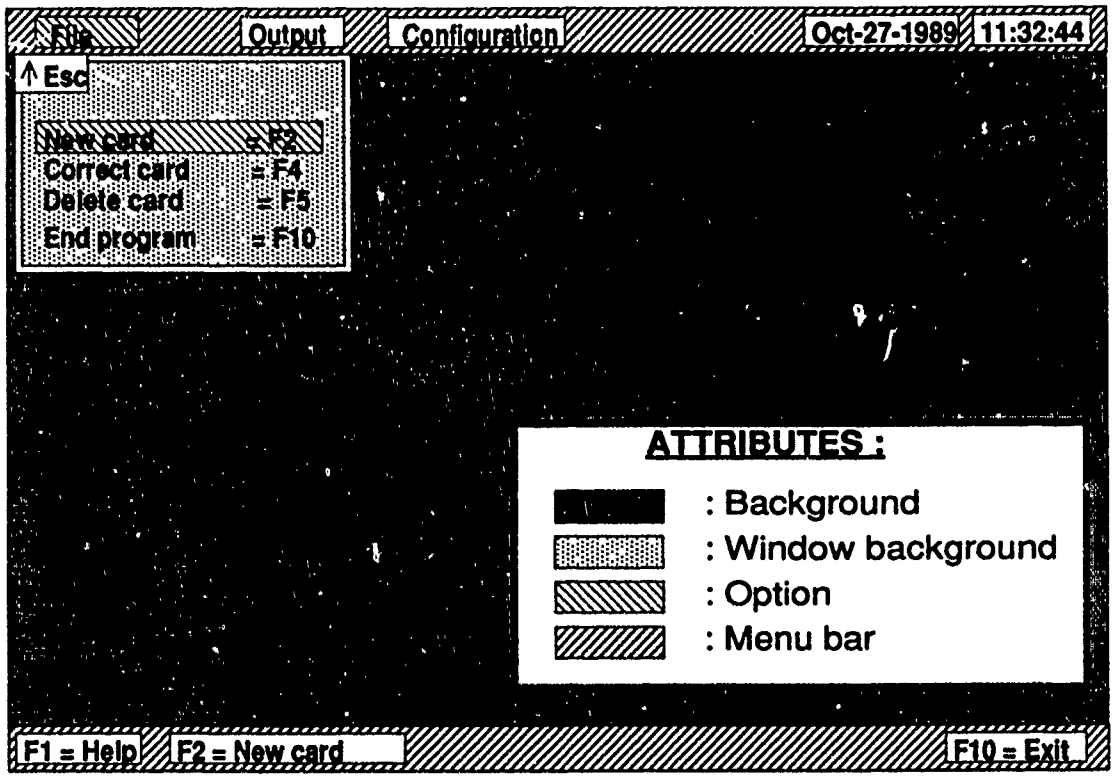


Figure 1 : Screen attributes and main menu.

II.1 - Presentation of the functions of the various menus :

- Main menu "**File**" :

Contains 4 options :
- Input of a new card,
- Correction of a card,
- Destruction of a card,
- End of software.

- Main menu "**Output**" :

Contains 3 options :
- Creation of an ASCII file on disk,
- Creation of an defineable ASCII file on disk,
- Printing cards,
- Backup on floppy disks.

The "ASCII File" option can be used to create an ASCII file of various entered cards (All data are coded by characters) in order to have an interface with softwares which accept importation of ASCII files.

The "Defined ASCII file" option is used to store data of one or several cards in an ASCII file. The file structure can be defined in order to adapt to the desired software. Cards can be imported to other commercial software such as LOTUS 123, EXCEL or Dbase III. configurations are given for these three softwares.

The "Printing cards" option is used to print the last page of the last displayed card, an entire card or several cards of the file.

Selection of one of the first two options shows a menu for selection of the output mode : Page, One card, File (several cards).

The option "Backup on floppy disks" permits transfer of cards stored in the file on hard disk onto one or several floppy disks in order to send entered data or save the file so it does not get lost in case of hard disk failure (cf V.6).

- Main menu "**Configuration**" :

It contains 3 options :
- Language,
- Screen attributes,
- Printer.

The "Language" option is used to select the display language wanted.

The "Screen attributes" option is used to define the various screen attributes. This option shows a sub-menu for selection of the various reconfigurable attributes (See figure 1) :
- Screen background : the attribute to display data of the pilot card,
- Window background : the attribute of displayed windows,
- Menu bar : the attribute of the 2 bar on first and last line,
- Option : the attribute of option selected in a menu.

The "Printer" option is used to define the ouput port on which the printer is connected. This output port can be either a parallel port numbered 1 to 3 (LPT1 to LPT3) or a serial port numbered 1 to 2 (COM1 or COM2). A menu appears, giving the output ports.

II.2 - Presentation of the card on the screen :

The various variables which make up the pilot's card are displayed on the screen as a certain number of screen pages grouping a type of data (See figure 2).

Page 1 :	Data on the type of study.
Page 2 :	Identification data.
Page 3 :	Flying history.
Page 4 :	Flying hours and smoking.
Page 5 :	Co-factors : cholesterol, height, blood pressure and sport.
Page 6, 7 :	Echocardiographic data.
Page 8, 9 :	Doppler data and other parameters.
Page 10,11 :	Other parameters followed.
Page 12,13 :	Variables calculated from basic variables.

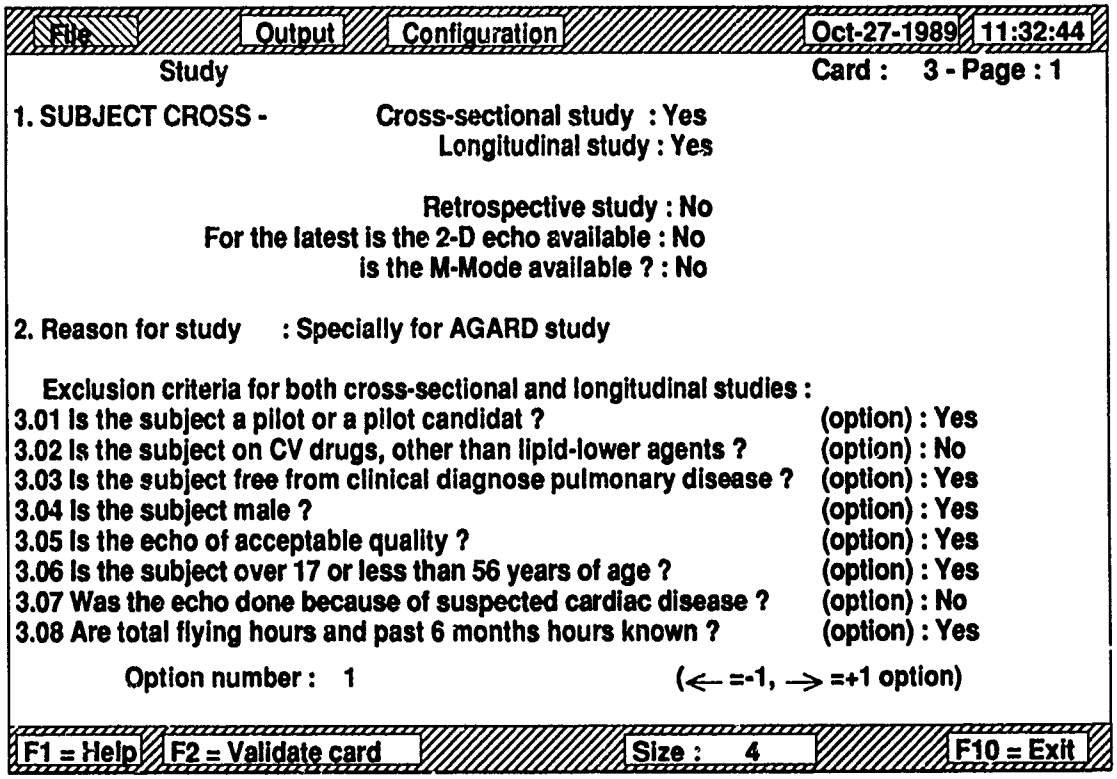


Figure 2-1 : Differents screen pages.

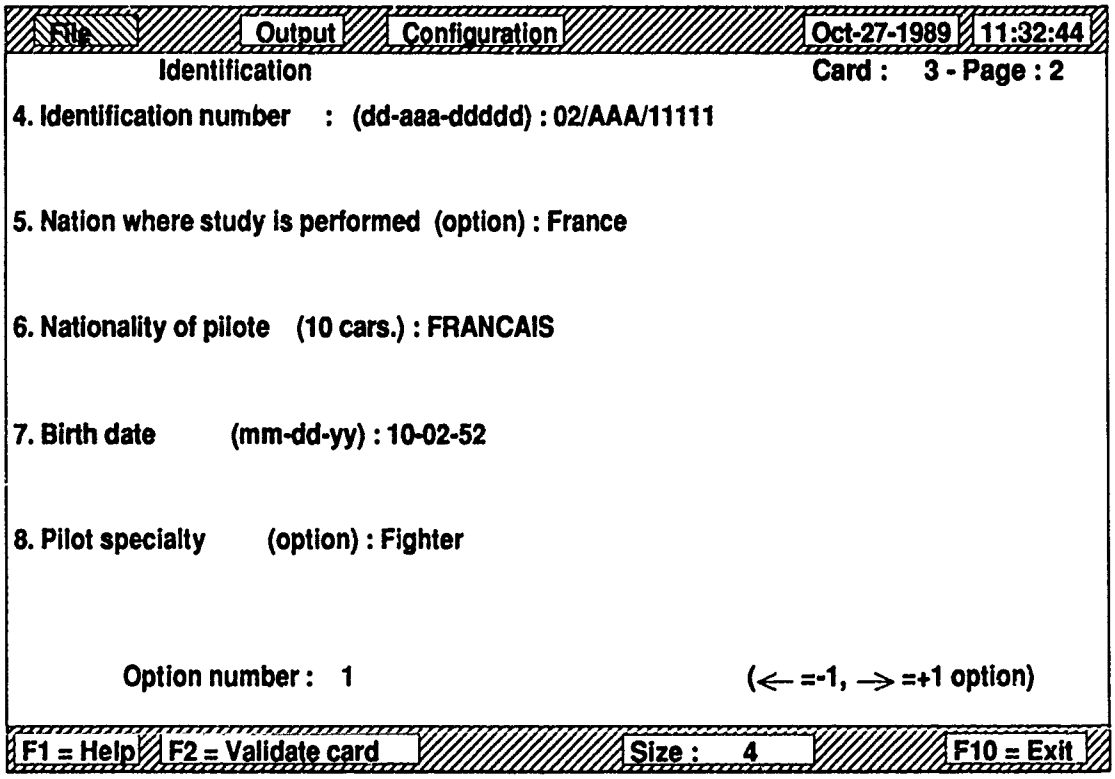


Figure 2-2 :

File | Output | Configuration | Oct-27-1989 | 11:32:44

Cofactors 1 — Card : 3 - Page : 3

9. MILITARY FLYING HISTORY : Chronological order

Date (Year)		Aircraft type		Flight
Begin	End	Name	Code	hours
1983	1989	Mirage 2000	83	210
ND	ND	Unknown or Non pilot	0	ND

Limits for this variable are : 1940 < X < 2040.

F1 = Help | F2 = Validate card | Size : 4 | F10 = Exit

Figure 2-3 :

File | Output | Configuration | Oct-27-1989 | 11:32:44

Cofactors 2 — Card : 3 - Page : 4

10. Total number of flight hours (hrs) : 210
11. Flying hours on HSG Aircraft (hrs) : 130
- Air combat (%) : ND
- Air intercept (%) : ND
- Air to ground (%) : ND
12. Last six months flying hours (hrs) : 45
- Air combat (%) : ND
- Air intercept (%) : ND
- Air to ground (%) : ND
14. Have you smoked ? (option) : Yes

Type	#Packs/Day	#Years
Cigarettes	0.5	6
Cigarillos	0.0	0
Cigars	0.0	0
Pipes	0.0	0

Total : 3

Limits for this variable are : 0.00 < X < 10.00 .

F1 = Help | F2 = Validate card | Size : 4 | F10 = Exit

Figure 2-4 :

File | Output | Configuration | Oct-27-1989 | 11:32:44

Cofactors 3 — Card : 3 - Page : 5

15. Sport Type I - Aerobic (option) : Light
Sport Type I - Isometric (option) : Light
Sport Type II - Sport quantity (Kj/week) : 7803.0
Sport class (calculated) : Mean

16. Size (cm) : 182
17. Weight (kg) : 75 Body area (calculated) (m2) : 1.96

18. BLOOD PRESSURE : (mm Hg)

	Seated	Supine
Systolic	130	ND
Diastolic	70	ND

19. Cholesterol (mean)(mg/dl) : 2.00
HDL Cholesterol (mean)(mg/dl) : 0.60

Enter to modify this variable !

F1 = Help | F2 = Validate card | Size : 4 | F10 = Exit

Figure 2-5 :

File | Output | Configuration | Oct-27-1989 | 11:32:44

Echocardiography 1 — Card : 3 - Page : 6

20. Date of echocardiography (mm-jj-aa) : 10-27-89

M-MODE MEASUREMENTS. 2D-directed, short axis, below mitral valve.

21	Right ventricular internal dimension / diastole	(cm)	2.00
22	Left Ventricular internal dimension / diastole	(cm)	5.00
23	Left Ventricular internal dimension / systole	(cm)	3.00
24	Septal thickness / diastole	(cm)	1.00
25	Septal thickness / systole	(cm)	1.00
26	Posterior wall thickness / diastole	(cm)	1.00
27	Posterior wall thickness / systole	(cm)	1.20
28	Aortic dimension	(cm)	3.00
29	Left atrial dimension	(cm)	4.00
30	Left Ventricular pre-ejection time	(ms)	70
31	Left Ventricular ejection time	(ms)	200
32	Mitral E-F slope	(mm/sec)	80
33	Heart rate	(bpm)	70

Limits for this variable are : 40 < X < 120 .

F1 = Help | F2 = Validate card | Size : 4 | F10 = Exit

Figure 2-6 :

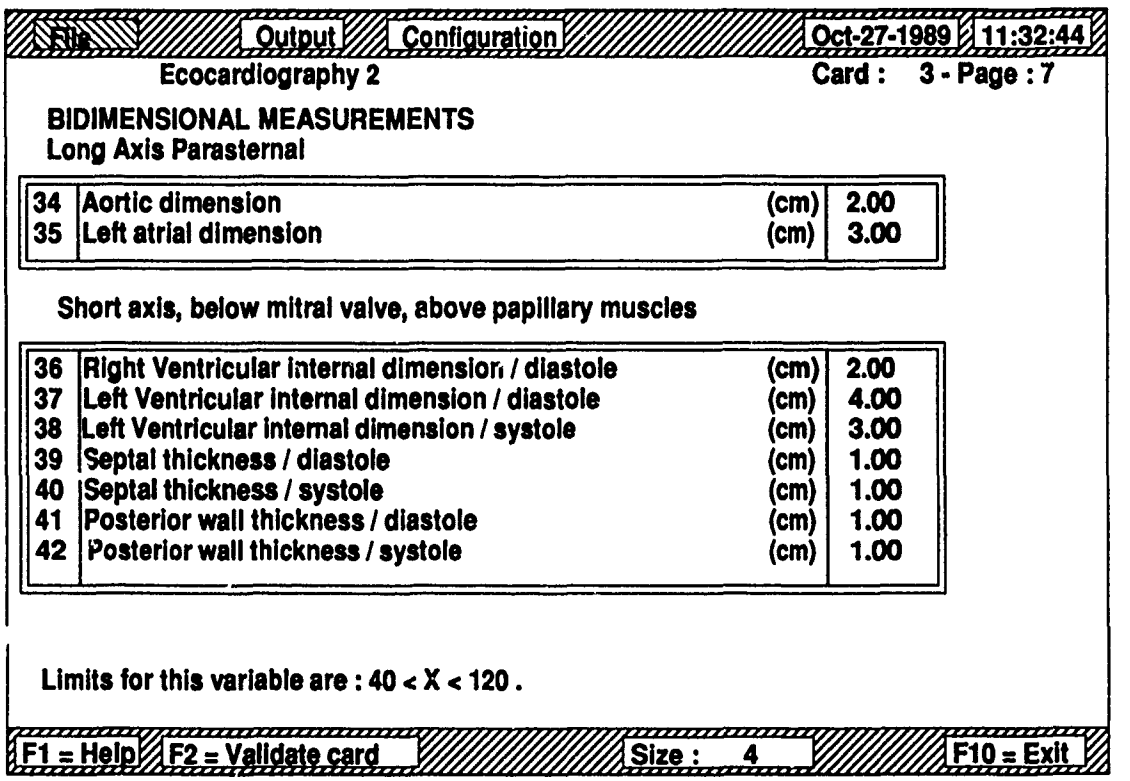


Figure 2-7 :

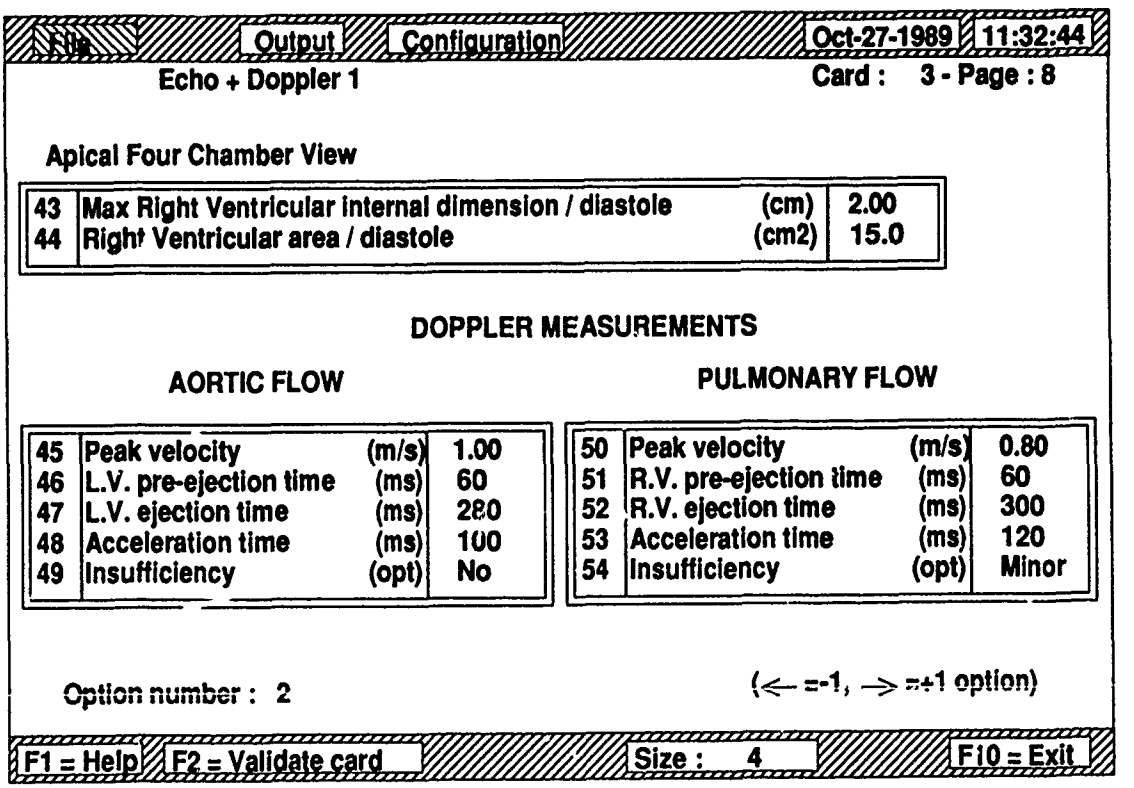


Figure 2-8 :

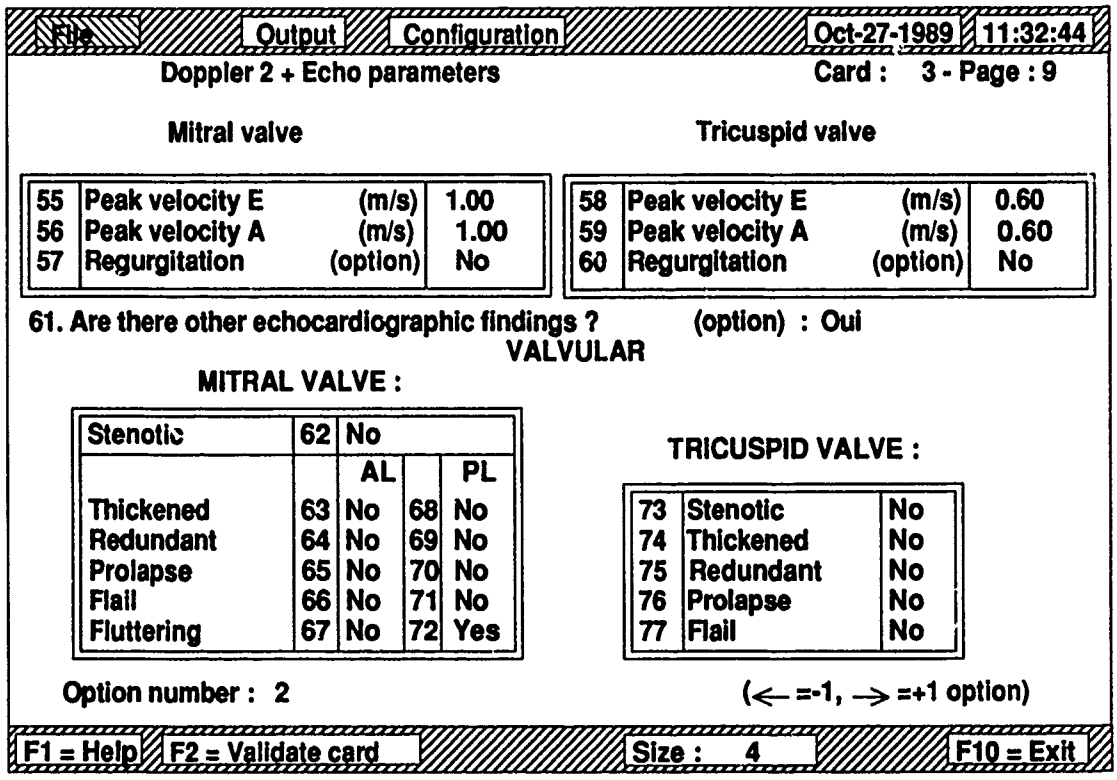


Figure 2-9 :

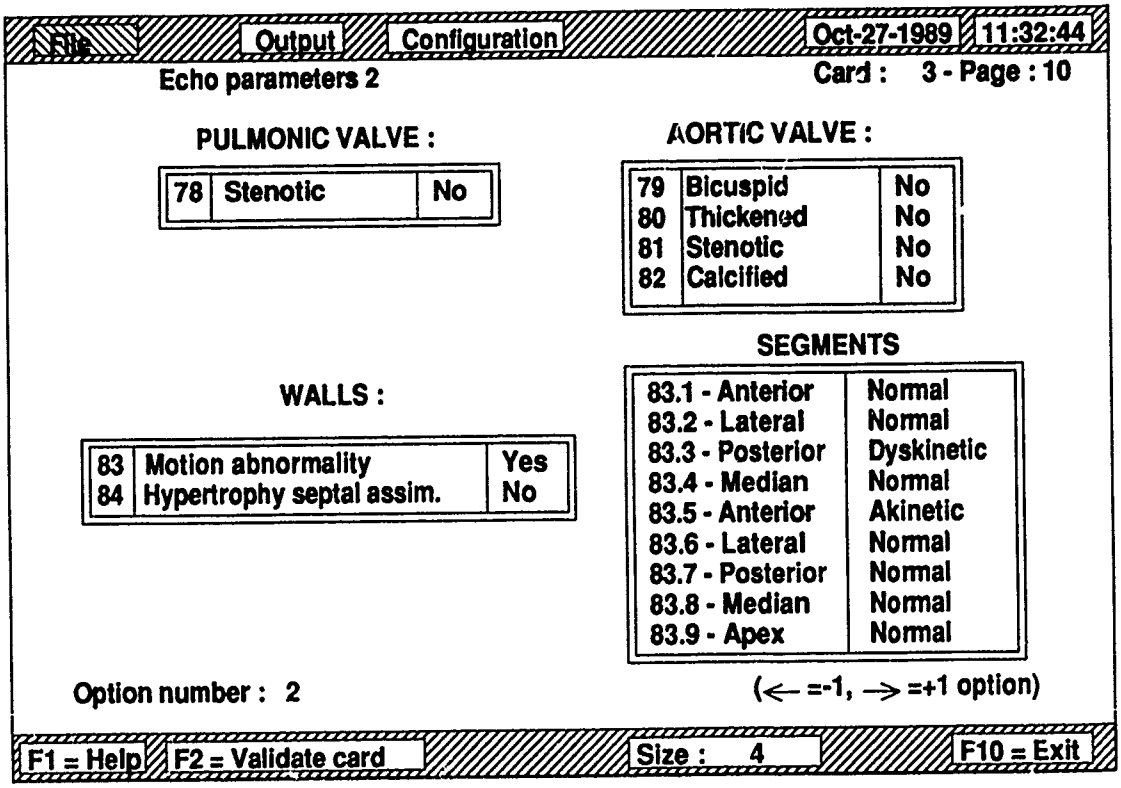


Figure 2-10 :

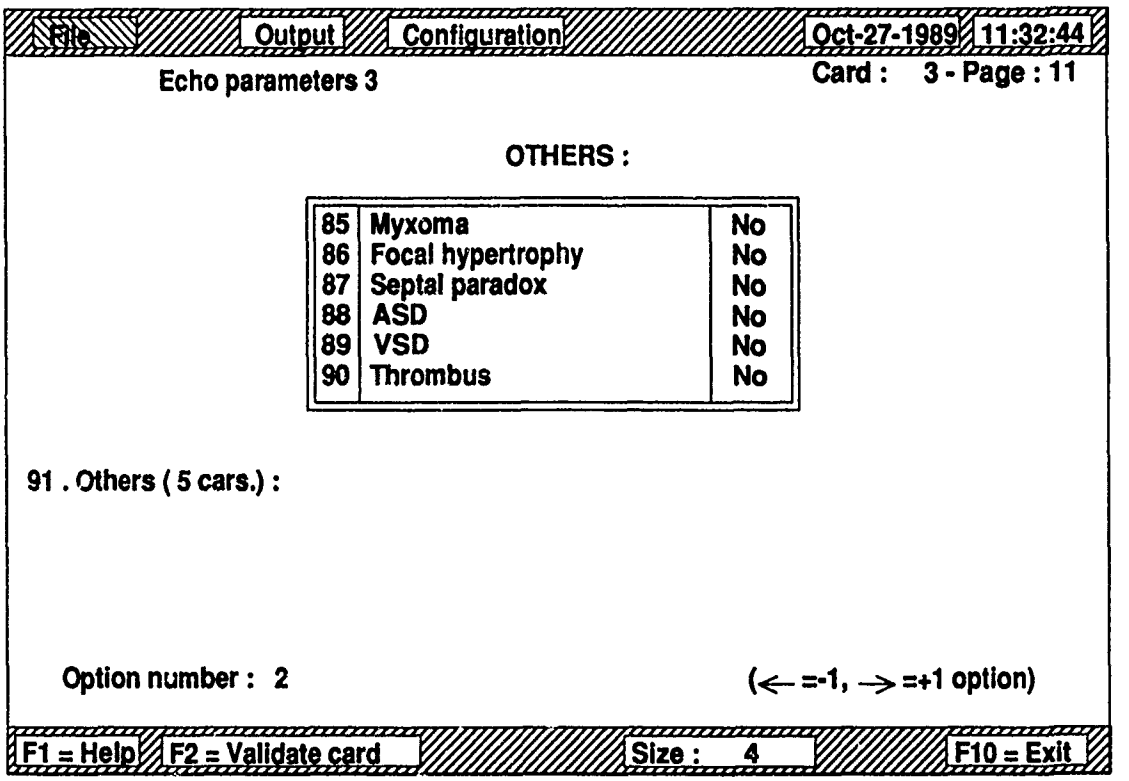


Figure 2-11 :

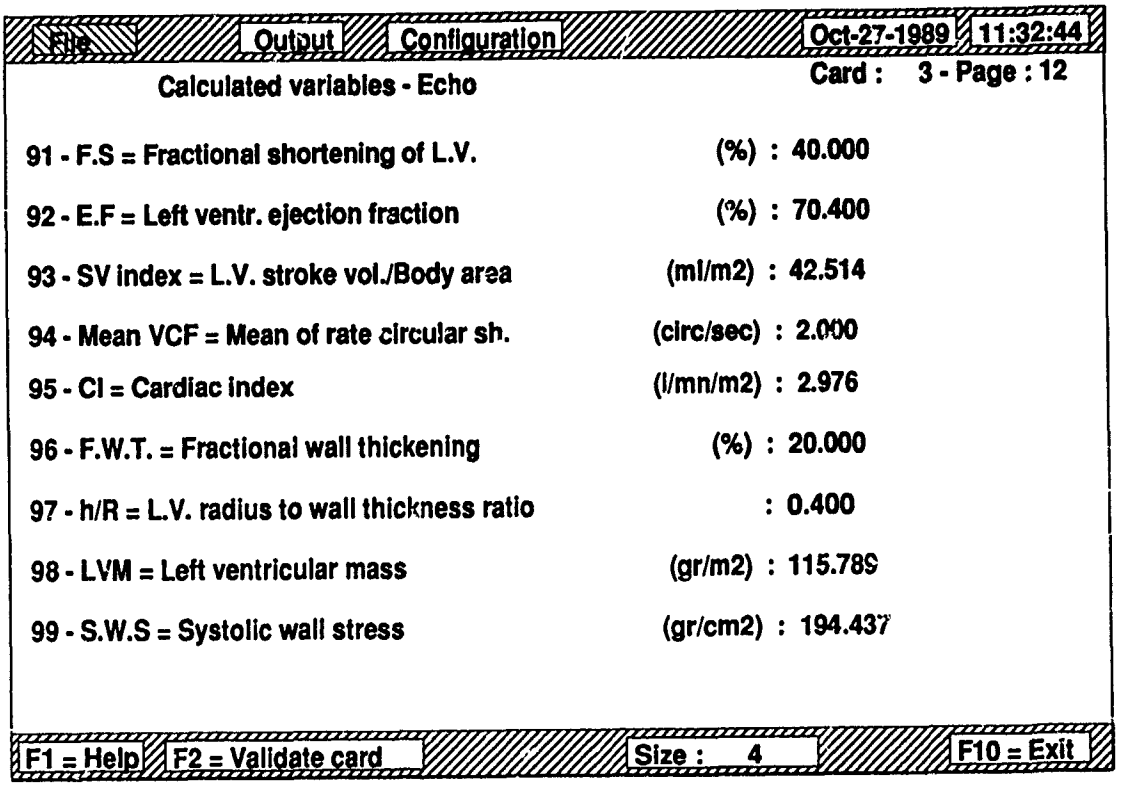


Figure 2-12 :

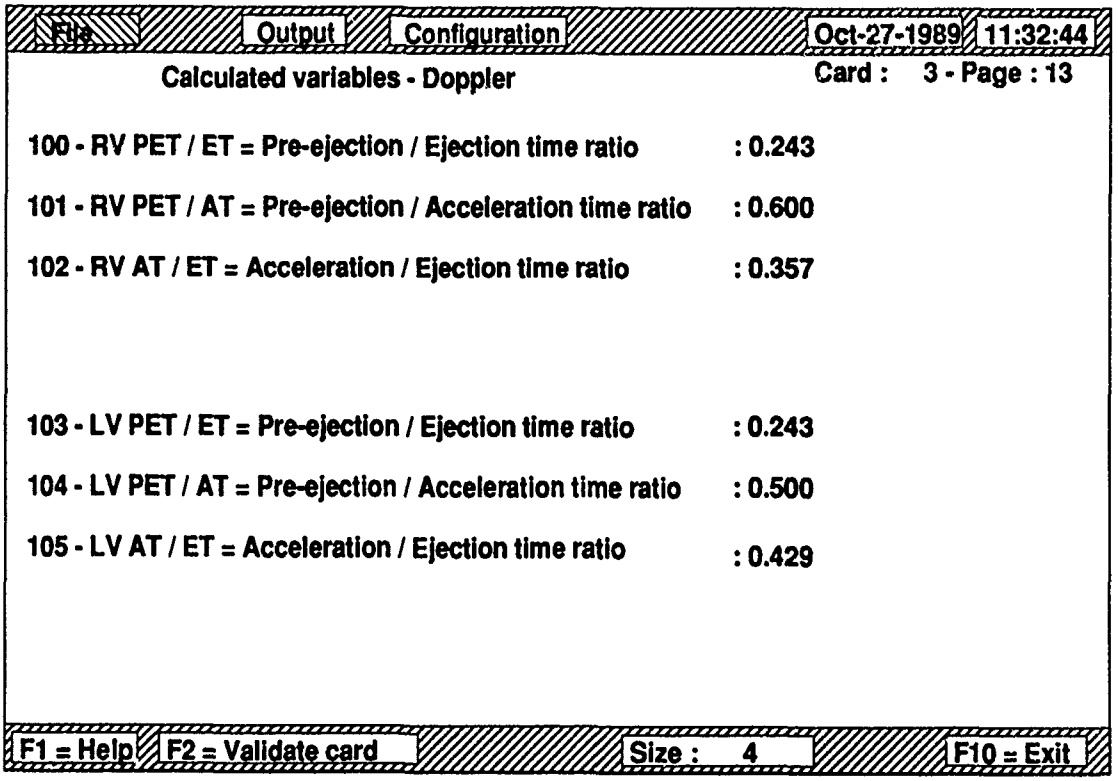


Figure 2-13 :

II.3 - Different types of variables :

- **"Character string"** variables :

These character strings are directly entered without any test except for the maximum length for each string. The maximum number of characters is given after the variable. (Example : Nationality)

- **"Formated character string"** variables :

These variables have a special pre-defined input format. For example : a date (format mm-dd-yy) or identification number (Format dd/ccc/ddddd). In this case, the input string is tested according to limit values or type of character (Digit (d) or Character (c)) required. Separation character "-" or "/" are not accessible. The required acquisition format is written on the screen. (Example : Date or Identification number)

- **"Integer as option"** variables :

These variables, coded as an integer, represent in fact the number of an option in a list. They are represented on the screen by the name of the option. For example : Type of pilote : "Unknown", "Fighter", "Transport", ... The Fighter pilot type will be represented by number 1and not by the character string "Fighter pilot". The user, therefore, does not enter the character string but selects one of the variable options in the predefined list. This name (option) specified that this variable is stored in the form of an option (Example : Pilot specialty or exclusion criteria). For the exclusion criterias, a window rappelle à l'écran les réponses types pour chaque critère (see figure 3).

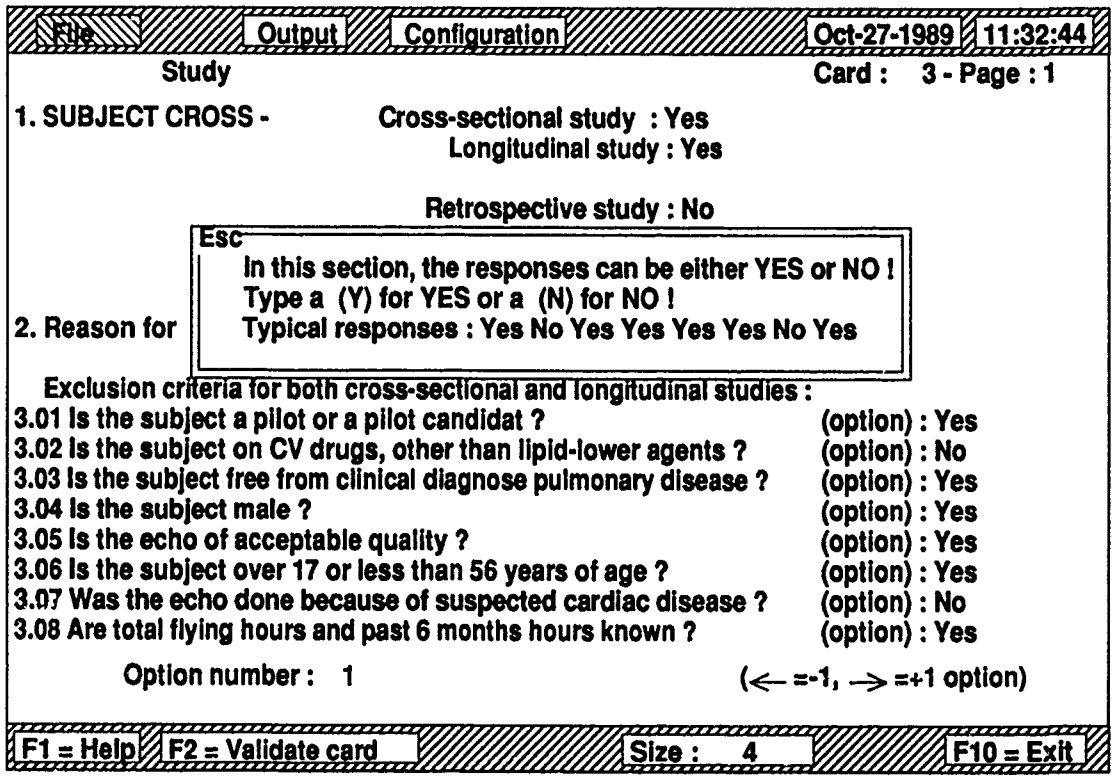


Figure 3 :

- **"Integer or real"** variable :

These variables are inputed and compared with predefined limits for these variables. The unit for each variable is given after the name.

The word "Unknown" appears in the list of pilot types. More precisely : The **SAS** software can be used to manage missing data in the file. Therefore any missing variable will be coded by value -1. **SAS** will then know that this variable is missing and will process it consequently.

II.4 - Hidden variables :

Certain variables must be inputed only under certain conditions, for example : the number of flying hours has no reason to be entered if the type of pilote entered is "Unknown" or "Non pilot - Control". In this case, variables will not be accessible and will not appear on the card. Each "Determining variable" is therefore tested and hides or shows other variables as needed !

II.5 - Calculated variables :

These variables calculated from basic variables are only displayed for memory and cannot be modified by the user. For example, the body area calculated from weight and height.

II.6 - Data files :

"PILOTS" stores various cards entered in a file which is created on the hard disk in the repertory "C:\PILOTS" and his name is "PILOTS.DAT". This working file is stored on the hard disk to work more rapidly than on floppy disks. An option can be used to transfer the file for statistical processing on one or several floppy disks according to file size. These transfert floppy disks can have any size : 5'1/4 or 3'1/2.

III . USE OF BASIC FUNCTIONS :

III.1 - Use of pop-up menus :

- Use with the keyboard :

Selection of a principal menu : Press keys ← or → to initiate the desired menu then press (Enter) to display this menu if it does not appear on the screen. Each menu can also be selected directly by pressing sequence ALT + first letter of this desired menu : Menu "File", press ALT F. (N.B. : the sequence Alt F ou Ctrl F means : keep Alt or Ctrl key pressed and then press F key !).

Selection of an option in a menu : Press keys ↑ and ↓ to initiate the desired option and type (Enter) to select this option. Each option can also be selected directly in an active menu (visible) by typing the only capital letter of the name of this option (For "Delete card" option, type "D"). Some options are accessible from anywhere by pressing a function key :

F2 to create a new card,
F4 to delete a card,
F5 to correct a card,
F10 to terminate acquisition.

Going back to previous menu : Press key Esc or Echap. (Escape or Echappement) to go back to previous menu or make a principal menu non active.

- Use of the mouse :

Selection of a principal menu : Point the name of the desired menu and click on one of the mouse buttons.

Selection of an option in a menu : Point the desired option and click.

Going back to previous menu : Point the "Esc" label of the menu window and click.
This action is equivalent to pressing the Escape key , it is valid for all windows which will be displayed by the software.

III.2 - Acquisition of a character string :

Note that any numerical variable is initialy a character string coding a number. The acquisition procedure of a character string is therefore used by all input functions of numerical variables.

The sequence Ctrl A entirely cancels the inputed string. The software usually propose another string which is the last inputed string. This string is cancelled by typing a character as first key. The software considers then that this string is not good. However, if you type a shift or editing key as first key (Suppr, Insert, etc...), the software will consider that the proposed string must be modified and it will not be erased.

Keys ← and → permit moving along the string.
Keys Ctrl ← and Ctrl → place the pointer at the beginning and at the end of the entered string.
Key Del or Suppr can be used to suppress the character pointed by the pointer whereas key Backspace suppresses the character to the left of the pointer.
Key Ins can be used to move into Insertion mode or to come back to Suppression mode. Note that the pointer becomes larger in Insertion mode.

III.3 - Acquisition of a formated character string :

Certain character strings have a fixed predefined format as the various dates. The input mode is identical to that of the character strings except for certain inaccessible functions not to modify the input format.

Keys and inaccessible functions :

Ctrl A and erasing string,
Backspace and Del,
Ins.

III.4 - Calling the help function :

The help function can be called by pressing on key F1. A window gives details on the available functions. You can go from a help page to another by pressing on keys ↑ and ↓ . Press on Escape key to exit from Help mode.

III.5 - Selection of an item in a list :

Common procedure is used to select an item in a list. It is used to select a card to delete or modify, to select one of the various possible attributes, finally to select one of the sports in the list. All these options will therefore be used in the same way.

Keys ← and → select the preceding or next item.
Keys Ctrl ← and Ctrl → place the pointer on the first or the last item of the line.
Keys ↑ and ↓ go to the preceding or next line.
Keys Home, End, Page Up and Page Down place the pointer on the item placed in one the four corners of the page of displayed items.
Keys Ctrl Home and Ctrl End place the pointer on the first or the last item in the list.
Keys Ctrl Page Up and Ctrl Page Down bring to the previous or next page in the list.

The mouse can directly position on the desired item. You can change pages with the mouse by clicking on the small ascending or descending arrows displayed on the verticals bars of the window.

To select, place the pointer on the desired item and type (Enter) or click on the mouse.

Note that the size and number of items in the list determine the number of items per line on the screen and the number of screen pages necessary to display the entire list. Certain keys will have no effect if there is only one item per line or only one screen page.

A rapid selection can be done using the keyboard. Type the first character from the item to select, selection routine will search within the list of desired item. Any new character typed is added at the end of the search string and can refine the research. Note that after 4 seconds between two keys, the routine will consider that a new research must be started and will cancel the entire string. The string being searched for is always recalled on the last line of the window.

To select a card, if you type a '#' character at the begining of the string, the card number will be searched, otherwise the identification number.

III.6 - Answer for YES-NO question :

Certain answers to a question are asked in a window. Answers are only YES or NO to confirm for example an out-of-limits value.
Answer this question by typing :
Keys O or N to answer directly Yes or No,
Keys ← and → to make desired answer active,
Key (Enter) to validate the active response.

To answer you can also click with the mouse on Yes or No.

IV . INPUT OR CORRECTION OF A CARD

For each variable in the card a help line appears on line 23 of the screen. For variables in the form of options, the number of options is given.

To go from place to place in the various pages in the card :

Keys ↑ and ↓ go to the preceding or next variable,
Keys Page Up and Page Down go to the preceding or next page,
Keys Home and End place the pointer in the first or last page.

Each acquisition of a variable (by the (Enter) key) sends to the next variable if the acquisition value is accepted !

IV.1 - Acquisition of identification number :

The identification number includes three distinct zones separated by "/" characters. The input format is fixed. The first zone composed of two digits codes the number of the country according to the same list as the "Nation of study" variable. The two zones composed of 3 letters and 5 digits are used to enter a code or number. The identification number is only accepted if the country code entered and reminding on line 23 is valid and if the other 2 zones only included letters for one and digits for the other.

IV.2 - Dates acquisition :

Dates have a fixed format. Separation characters "-" are inaccessible. They are composed of the month and year or day, month and year. The order of entry changes according to the nationality. For French : Day-Month-Year. For English : Month-Day-Year. The year is coded on the last two digits (89 for 1989). The date is acceptable only if it is valid.

IV.3 - Acquisition of a numerical variable :

Numerical variables are of two types : Integer or Real. They are tested against minimal and maximal limits. No value out of these limits will be accepted. Limits are reminded on line 23. For some of them, echocardiographic values in particular, two extra limits are given called pathological limits.

Here are the differents cases that can appear according to the inputed value :

Value < Minima :	Non accepted value.
Minima < Value < Pathological minimum :	You must confirm.
Pathological minimum < Value < Pathological maxi. :	Accepted value.
Pathological maximum < Value < Maxima :	You must confirm.
Maxima < Value :	Non accepted value.

A pathological value is confirmed using a window in which pathological limits are reminded for the processed variable. If you do not confirm the value, you must enter another one. Otherwise the value will be accepted.

Note that for real variables the coma can be either a point curently used in computer language or a coma. "1.2" and "1,2" will therefore be accepted.

IV.4 - Acquisition of a numeric variable in the form of an option :

These variables stored in the file in the form of an integer represent the number of an option in a list. The option appears on the screen whereas the number of the processed option is given in line 23. Here are some details on the various means of selecting the desired option :

Keys ← and → are used to go to the preceding or following option,
Keys Cltr Home and Ctrl End go to the first or last option in the list.

You can display the desired option by simply typing the first letter of this option. In case you press an digital key, the software start searching from the option currently selected the first option starting with this character. Typing again this character will initiate search of the second option starting with this character, etc...

IV.5 - Acquisition of the sport quantity :

Calculation of the sport quantity is done directly from the weight of individual and the time of practice of every sports. This variable is modified by typing (Enter) when the variable "Sport quantity" is selected. A selection window appears. You must select the various sports practiced by the pilot by typing (Enter) or clicking on the desired sport then entering the number of the mean number of minutes of practice per day, the mean number of days per week and the number of weeks for the last six months.

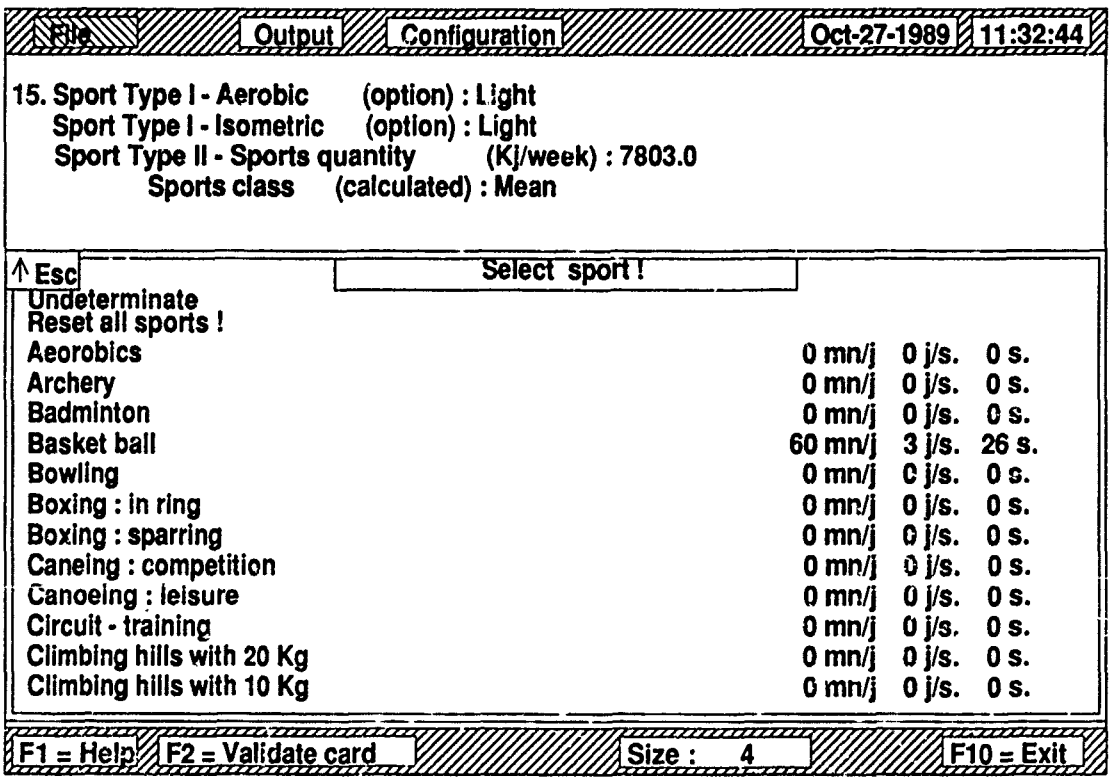


Figure 4-1 : Sport selection window.

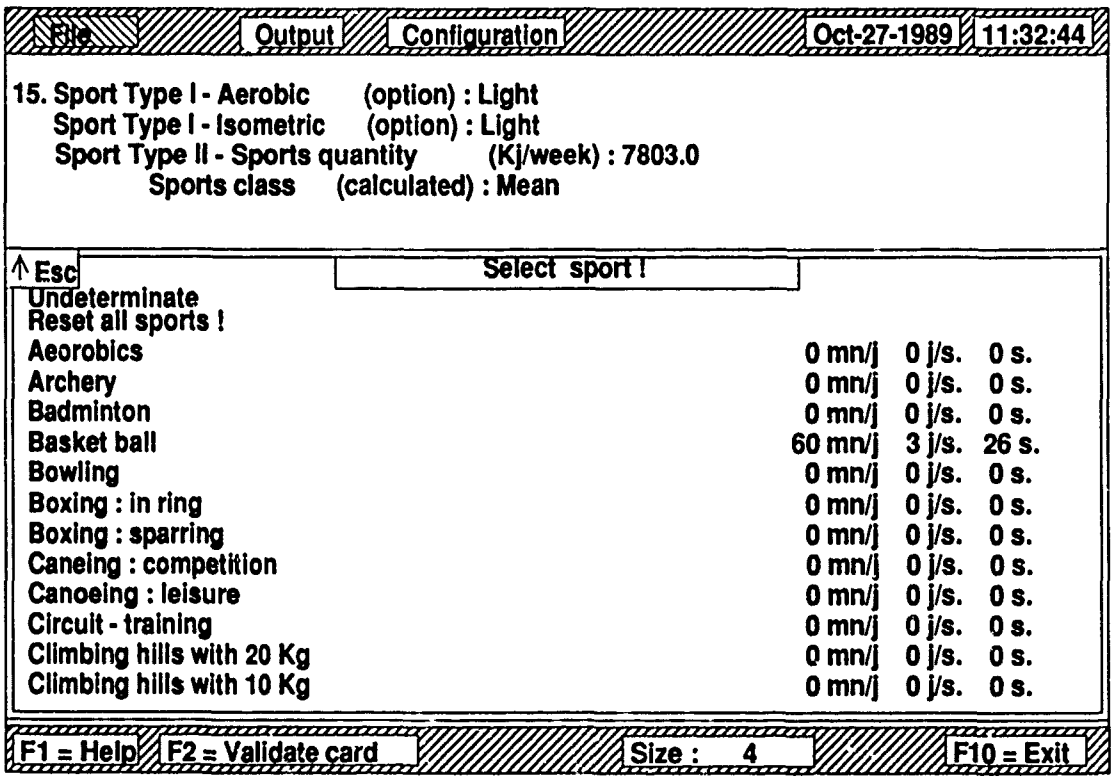


Figure 4-2 : Acquisition window for various amounts of sport.

The software will calculate the sport quantity as the function of the entered data. At any moment you can come back to the list to change the entered data. The first two items on the list are used first to reposition the sport quantity at -1 (Indeterminate value) and two, to reset to zero all quantities entered in case of error.

Figure 4-1 shows the selection window for the various sports. (See in appendix the list of the various sports). Figure 4-2 shows the acquisition windows of the various amounts for a sport.

IV.6 - Indeterminates or unknows variables :

Each numerical variable in the card can be positioned as unknown or Indeterminate. It will then be coded in the card by value -1 and identified by SAS which will process it as missing. To indicate that a variable is missing enter value -1 or type "ND" for No Data or Not Determined. The software displays missing values by the letters "ND".

V . USE OF OPTIONS

V 1 - Entering a new card :

Enter the new card using the various functions detailed in chapter IV and validate the card by pressing F2 key.

The card will not be written in the file as long as it is not validated !

V.2 - Deleting a card :

Select desired card with selection routine and confirm deletion of this card through a YES-NO window.

Note that the card is not physically destroyed at the moment of deletion. See note given in chapter VI.

V.3 - Correcting a card :

Select card to be corrected, enter changes and validate them by typing F2 key as for option "Enter a new card".

V.4 - Output to a printer or in an ASCII file :

These two options can be used either for output of entered cards on a printer or to create an ASCII file containing the various cards and to be used as interface with other commercial softwares. These two options are nearly identical.

They can be used for output of either :

- The last displayed page in the last entered or modified card.
- One card of the file. In this case you must enter the number of the card for output.
- All or several cards of the file. In this case you must enter the number of the first and the last card for output. The software proposes the number of the first and the number of the last card of the file. If these proposals are convenient, press (Enter) key.

Various options appear which can used to modify the structure of the output :

- You can output or not the name of each variable. The name is the sentence displayed before each variable and the unit of this variable.

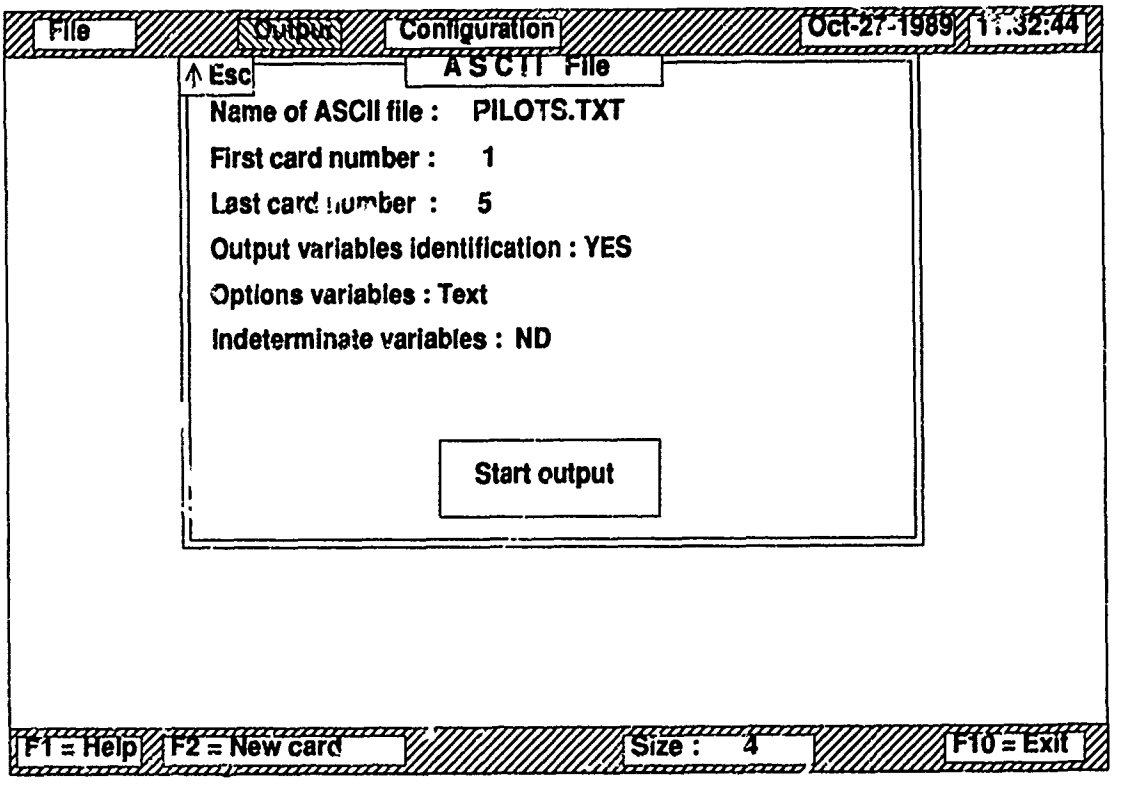


Figure 5.1 : Output window for an ASCII file.

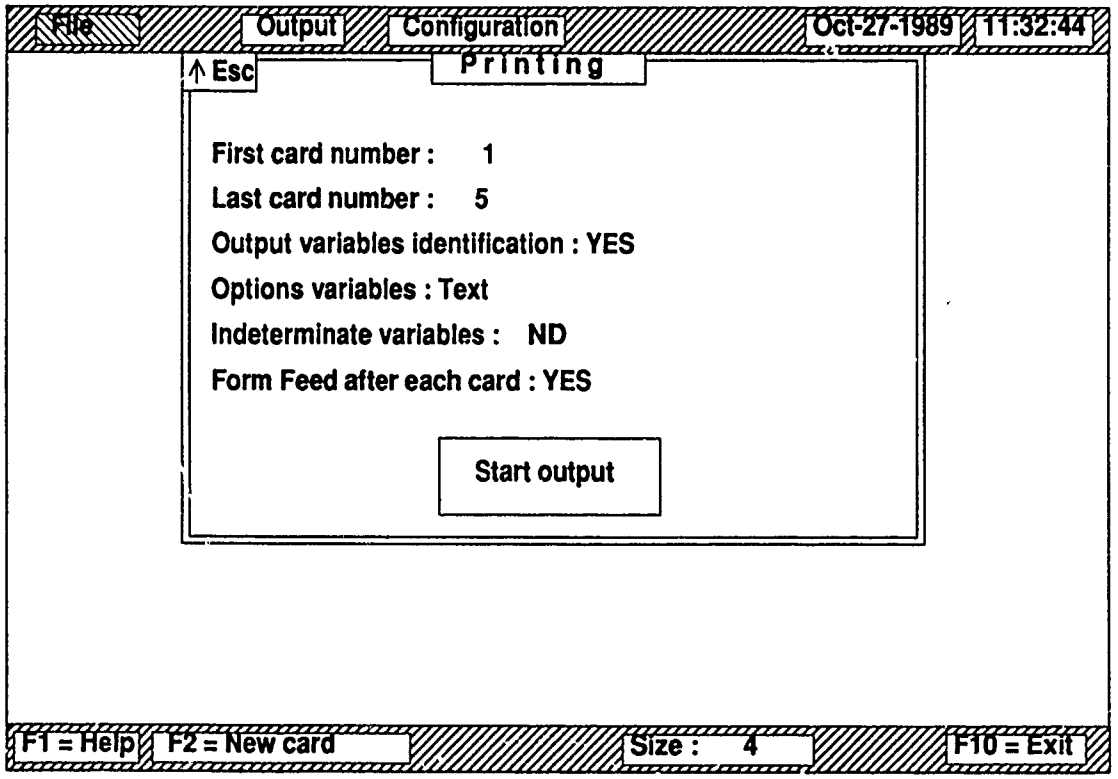


Figure 5-2 : Output window to a printer.

- You can output for each option variable the name of the entered option or the number coding this option.

- You can output Indeterminate variables by the letter "ND" or simply by the digit -1.

To output on a printer, a Form Feed character can be sent to the printer after each outputed card in order to separate the various cards.

We shall now describe the various functions which can be used to modify the output configuration.

Keys Up and Do select previous or following option.

Keys Home and End position the pointer on the first or last function.

Pressing the key (Enter) has a different effect depending of the position of the pointer :

On entering the name of the file or one of the two card numbers = moving to the next option.
On one of the output option = change type of selected option.
On the "Start output" window = initiate output or printing.

Typing on Escape key cancels output.

With the mouse :

The mouse can be used to move from one option to the next.

Clicking one of the output options changes the type of the option selected as the (Enter) key.

Clicking in the "Start output" window initiates output or printing.

Finally note that the "Start output" window for an ASCII file is only accessible if you have entered a valid output file name ! For each change in the name of the file, PILOTS attemps to create the required file. If the creation is not a success, the name of the file is not valid. For example, if you enter a non valid file name, an inexisting repertory, a non valid DOS unit.

Examples of valid file names :

PILOTS.TXT C:\PILOTS\PILOTS.TXT

Examples of non valid file names :

PILOTS..TXT C:\PIL\PILOTS.TXT (PIL repertory does not exist)
C:\\PILOTS.TXT F:PILOTS.TXT (unit F: does not exist)
etc...

Figure 6 shows the various outputs according to the three possible options. Proposed options can be used to obtain a complete listing of the card such as it is displayed on the scroen. If the file must be used as interface with another software, you will certainly have to suppress the name of variables, output the options in digital form and Indeterminate variables as "-1".

Card number (dddddd) : 3
1. SUBJECT CROSS - Cross-sectional study : Yes
Longitudinal study : Yes
Retrospective study : No
For the latest is the 2-D echo available ? : No
is the M-Mode available ? : No
2. Reason for study : Specially for AGARD study
4. Identification number (dd-aaa-ddddd) : 02/AAA/11111
5. Nation where study is performed (option) : France
6. Nationality of pilot (10 cars.) : FRANCAIS
7. Birth date (mm-dd-yy) : 10-02-50
8. Pilot speciality (option) : Fighter
9. MILITARY FLYING HISTORY : Chronologic order

Date (Year)		Aircraft type		Flight
Begin	End	Name	Code	hours
1983	1989	Mirage 2000	83	210
ND	ND	Unknown or Non pilot	0	ND

10. Total number of flight hours (hrs) : 210
11. Flying hours on HSG Aircraft (hrs) : 130
- Air combat (%) : ND
- Air intercept (%) : ND
- Air to ground (%) : ND
12. Last six months flying hours (hrs) : 45
- Air combat (%) : ND
13. Date last flow (mm-jj-aa) : 11-08-89
- Air to ground (%) : ND
14. Have you smoked (option) : Yes

Type	#Packs/day	#Years
Cigarettes	0.5	6
Cigarillos	0.0	0
Cigares	0.0	0
Pipes	0.0	0

Total : 3 Years since quitting (Year) : ND
15. Cholesterol (mean) (mgr/dl) : 2.00
HDL Cholesterol (mean) (mgr/dl) : 0.60

18. BLOOD PRESURE : (mm Hg)

	Seated	Supine
Systolic	130	ND
Diastolic	70	ND

19. Sport Type I - Aerobic (option) : Light
Sport Type I - Isometric (option) : Light
Sport Type II . Sport quantity (Kj/week) : 7803.0
Sports class (calculate) : Mean
20. Date of the echo exam (mm-jj-yy) : 10-27-89
M-MODE MEASUREMENTS. 2D-directed, short axis, below mitral valve.

22	Right Ventricular internal dimension / diastole	(cm)	2.00
23	Left Ventricular internal dimension / diastole	(cm)	5.00
22	Left Ventricular internal dimension / systole	(cm)	3.00
25	Septal thickness / diastole	(cm)	1.00
26	Septal thickness / systole	(cm)	1.00
27	Posterior wall thickness / diastole	(cm)	1.00
28	Posterior wall thickness / systole	(cm)	1.20
29	Aortic dimension	(cm)	3.00
30	Left atrial dimension	(cm)	4.00
31	Left Ventricular pre-ejection time	(cm)	70
32	Left Ventricular ejection time	(cm)	200
33	Mitral E-F slope	(mm/sec)	80
34	Heart rate	(bpm)	70

BIDIMENSIONAL MEASUREMENTS
Long Axis Parasternal

35	Aortic dimension	(cm)	2.00
36	Left atrial dimension	(cm)	3.00

Short Axis, below mitral valve, above papillary muscles

38	Right Ventricular internal dimension / diastole	(cm)	2.00
39	Left Ventricular internal dimension / diastole	(cm)	4.00
40	Left Ventricular internal dimension / systole	(cm)	3.00
41	Septal thickness / diastole	(cm)	1.00
42	Septal thickness / systole	(cm)	1.00
43	Posterior wall thickness / diastole	(cm)	1.00
44	Posterior wall thickness / systole	(cm)	1.00

Apical Four Chamber View

45	Max Right Ventricular internal dimension/ diastole	(cm)	2.00
46	Right Ventricular area / diastole	(cm)	15.0

Figure 6-1 :

DOPPLER MEASUREMENTS

AORTIC FLOW			PULMONARY FLOW		
47	Peak velocity (m/s)	1.00	52	Peak velocity (m/s)	0.80
48	L.V. pre-eject time (ms)	60	53	L.V. pre-eject time (ms)	60
49	L.V. ejection time (ms)	280	54	L.V. ejection time (ms)	300
50	Acceleration time (ms)	100	55	Acceleration time (ms)	120
51	Insufficiency (opt)	No	56	Insufficiency (opt)	Minor

Mitral Valve			Tricuspid Valve		
57	Peak velocity E (m/s)	1.00	60	Peak velocity E (m/s)	0.60
58	Peak velocity A (m/s)	1.00	61	Peak velocity A (m/s)	0.60
59	Regurgitation (option)	No	62	Regurgitation (option)	No

63. Are there any other echocardiographic findings ? (option) : Yes

VALVULAR

MITRAL VALVE :

Stenotic	64	No		
	AL		PL	
Thickened	65	No	70	No
Redundant	66	No	71	No
Prolapse	67	No	72	No
Flail	68	No	73	No
Fluttering	69	No	74	Yes

TRICUSPID VALVE :

75	Stenotic	No
76	Thickened	No
77	Redundant	No
78	Prolapse	No
79	Flail	Yes

PULMONIC VALVE :

80	Stenotic	No

AORTIC VALVE :

81	Bicuspid	No
82	Thickened	No
83	Stenotic	No
84	Calcified	No

WALLS :

85	Hypokinetic segment	No
86	Dyskinetic segment	No
87	Assym. septal hypertophy	No

OTHER :

88	Myxoma	No
89	Focal hypertrophy	No
90	Septal paradox	No
91	ASD	No
92	VSD	No
93	Thrombus	No

94. Autre (5 cars.) : TEST

F.S = Fractional shortening of L.V (%) : 40.0000
E.F = Left ventr. ejection fraction (%) : 70.4000
SV index = L.V. stroke vol./Body ar.(ml/m2) : 42.5138
Mean VCF = Mean rate of circ. sh.(circ/sec) : 2.0000
CI = Cardiac index (l/mn/m2) : 2.9760
F.W.T. = Fractional wall thickening (%) : 20.000
h/R = L.V. radius to wall thick. ratio : 0.4000
LVM = Left ventricular mass (gr/m2) : 115.7899
S.W.S = Systolic wall stress (gr/cm2) : 149.5739
RV PET / ET = Pre-eject/Eject time ratio : 0.2143
RV PET / AT = Pre-eject/Accel. time ratio : 0.6000
RV AT / ET = Accelera. / Eject time ratio : 0.3571
LV PET / ET = Pre-eject/Eject time ratio : 0.2143
LV PET / AT = Pre-eject/Accel. time ratio : 0.5000
LV AT / ET = Accelera. / Eject time ratio : 0.4286

Figure 6-1 (end) : Complete output.

```
3
Yes
Yes
No
No
No
Specially for AGARD study
No  Yes Yes Yes Yes
No  Yes Yes
Yes No  Yes Yes Yes Yes No  Yes
02/AAA/11111
France
FRANCAIS
10-02-50
Fighter
1983 1989 Mirage 2000          210
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
 -1   -1 Unknown or Non pilot    -1
210
130
ND
ND
ND
45
ND
ND
ND
11-08-89
Yes
 0.0   0
3
ND
2.00
0.60
182
75
1.96
130
70
ND
ND
Light
Light
7803.0
Mean
10-27-89
2.00
5.00
3.00
1.00
1.00
1.00
1 20
3.00
4.00
70
200
80
70
2.00
3.00
2.00
4.00
3 00
1.00
1.00
1.00
1.00
2.00
15.00
1.00
60
260
100
No
0.80
60
300
                                                                    120
                                                                    Minor
                                                                    1.00
                                                                    1.00
                                                                    No
                                                                    0.60
                                                                    0.60
                                                                    No
                                                                    Yes
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    Yes
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    No
                                                                    TEST
                                                                    40.0000
                                                                    70.4000
                                                                    42.5138
                                                                    2.0000
                                                                    2.9760
                                                                    20.0000
                                                                    0.4000
                                                                    115.7899
                                                                    149.5739
                                                                    0.2143
                                                                    0.6000
                                                                    0.3571
                                                                    0.2143
                                                                    0.5000
                                                                    0.4286
```

Figure 6-2 : Output without variable names.

```
3
1
1
0
0
0
0
0 1 1 1 1
0 1 1
1 0 1 1 1 1 0 1
02/AAA/11111
3
FRANCAIS
10-02-50
0
1983 1989 82   210
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
 -1  -1 -1   -1
210
130
-1
-1
-1
45
-1
-1
-1
11-08-89
1
 0.0   0
3
-1
2.00
0.60
182
75
1.96
130
70
-1
-1
1
1
7803.0
2
10-27-89
2.00
5.00
3.00
1.00
1.00
1.00
1.20
3.00
4.00
70
200
80
70
2.00
3.00
2.00
4.00
3.00
1.00
1.00
1.00
1.00
2.00
15.00
1.00
60
280
100
0
0.80
60
300
120
1
1.00
1.00
0
0.60
0.80
0
1
0
0
0
0
0
0
0
0
0
0
1
0
0
0
0
1
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
TEST
40.0000
70.4000
42.5138
2.0000
2.9760
20.0000
0.4000
115.7899
149.5739
0.2143
0.6000
0.3571
0.2143
0.5000
0.4286
```

Figure 6-3 : Output without wording of variables and options names and indeterminate variable as (-1).

V.5 - Output in a definable ASCII file :

This option is used tc create an ASCII file containing one or several cards of the file according to a writing format known by a commercial software capable of importing this type of file. File structure is totally definable in order to adapt to the format required by this software. Finally, this option allows you to select variables which you want to output.

PILOTS has five possible configurations. You will be asked, by a menu, to select your configuration. A configuration is delivered for three softwares : EXCEL, LOTUS 123 and Dbase III. Two empty configurations remain for other softwares. After selecting the configuration a window appears for :

- the name of the configuration (this name is used in the configuration selection menu),
- the name of the output file,
- the file structure,
- the various variables wanted in the file.

Figure 7-1 shows the structure of this window.

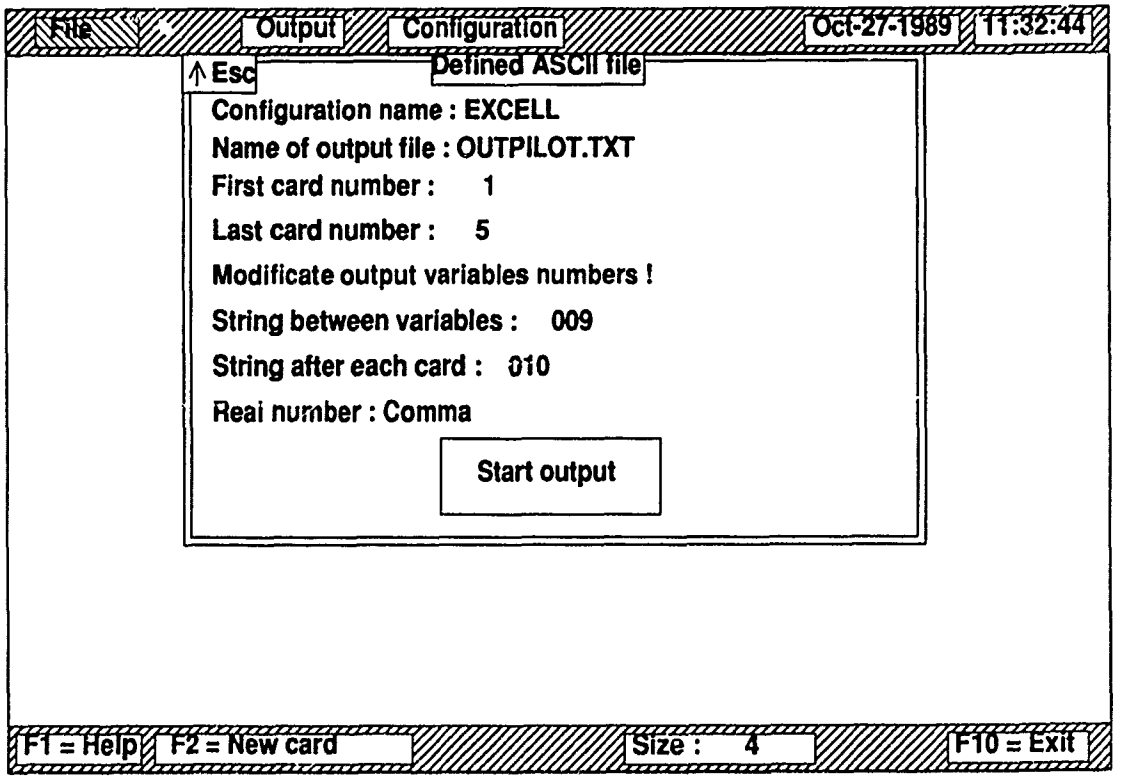


Figure 7-1 :

This window is similar to the printing definition window. Motions options in this window are therefore similar.

Definition of the file structure :

You must define the character string separating variables in a card, the character string separating two cards, the type of character coding real numbers (comma or period) and the delimiter for character string variables (character " or nothing).

The separating character strings contain at the most 5 characters.

For EXCEL for example : variables must be separated by a tabulation (code 9), cards by a character LF (Line Feed code 10), real numbers coded by a comma (1,2 is accepted whereas 1.2 is not) and no delimiter for character string variables.

You must enter these strings separating characters to be sent by a comma and typing either the code of the wanted character, or directly, the character if it can be displayed. For example, to enter an "ESC[1" character string, you can type either 27,[,1 or 27,91,49 or ESC,[,49. You will find in the appendix the list of character codes available on IBM PC. PILOTS will consider that you directly type the character if the space between two commas is one character. To enter a code 9 (TAB) you have to type 09 ! You can also enter the most frequent codes by typing directly their names (TAB for Tabulation, CR for Carriage Return, etc...). These codes are underlined in the list given in the appendix.

Selection of output variables :

To modify the various output variables click or type (Enter) on the word "Change in output variables". A selection window will appear, indicating variables which will come out in the file. Selected variables appear with the selection attribute. Modify the various variables using functions described for the selection routine. The number "Card" is used to include the card number at the beginning of each card. Figure 7-2 shows the selection window of variables and figure 7-3 the acquisition of 20 cards in EXCEL with the desired basic configuration. This file and files for LOTUS and Dbase are on the floppy-disk containing the software (PILOTS.XLS, PILOTS.WK1, PILOTS.DIF).

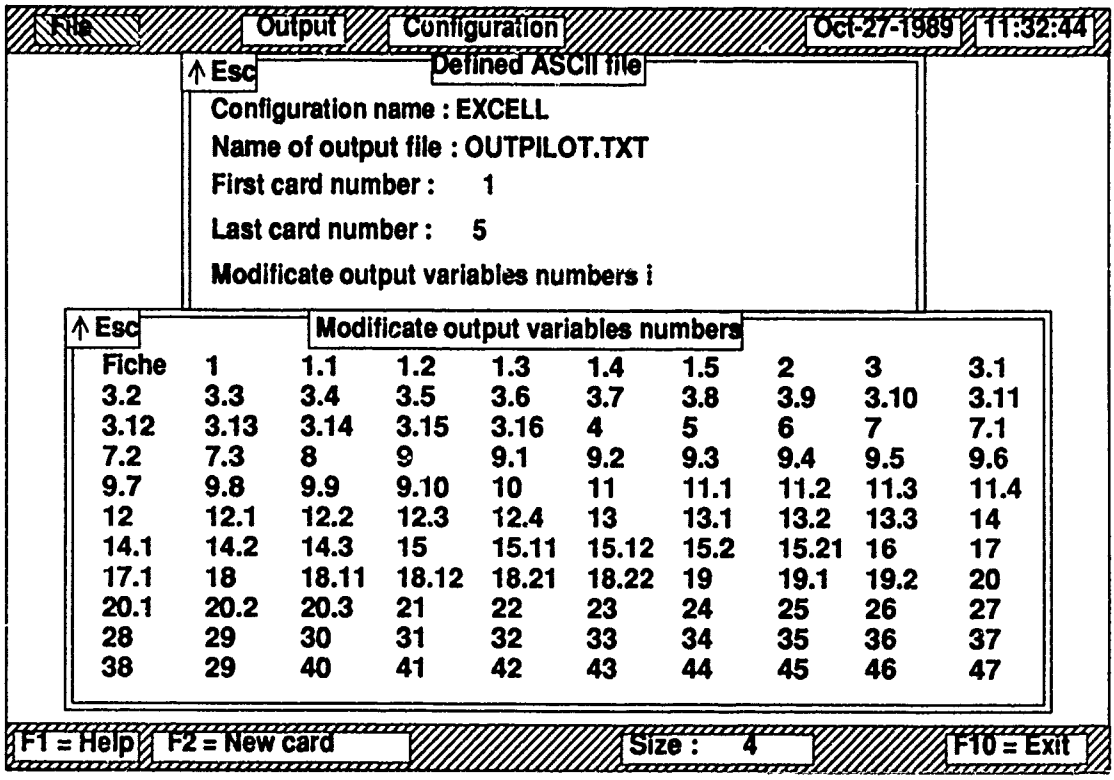


Figure 7-2 :

Each variable is referred to by its number in the work-sheet. For numbers containing several variables like exclusion criterias (3.1-3.17), you can either select number 3 which will output all variables of this subdivision, or select wanted variables one by one. You will find the correspondance between numbers and variables in the appendix.

	A	B	C	D	E	F	G	H	I	J
1		1.1	1.2	2	3	3	3	4	5	6
2						Exclusion criteria				
3	Fiche	Longitudinal	Cross-sectional	Reason study	Cross + Long	Cross	Long	Ident. number	Country study	Nationality
4	1	-1	-1	2	189	30	6	04/COR/00001	4	3
5	2	-1	-1	2	189	30	6	04/CAN/00002	4	3
6	3	-1	-1	2	189	30	6	04/PER/00003	4	3
7	4	-1	-1	2	189	30	6	04/ACT/00004	4	3
8	5	-1	-1	2	189	30	6	04/BEY/00005	4	3
9	6	-1	-1	2	189	30	6	04/DES/00006	4	3
10	7	-1	-1	2	189	30	6	04/CLA/00007	4	3
11	8	-1	-1	0	189	30	6	04/BOU/00008	4	3
12	9	-1	-1	0	189	30	6	04/DUR/00009	4	3
13	10	-1	-1	2	189	30	6	04/STI/00010	4	3
14	11	-1	-1	0	189	30	6	04/VIA/00011	4	3
15	12	-1	-1	0	189	30	6	04/JUI/00012	4	3
16	13	-1	-1	0	189	30	6	04/ALB/00013	4	3
17	14	-1	-1	2	189	30	6	04/DUC/00014	4	3
18	15	-1	-1	2	189	30	6	04/SAG/00015	4	3
19	16	-1	-1	2	189	30	6	04/ARN/00016	4	3
20	17	-1	-1	2	189	30	6	04/MAX/00017	4	3
21	18	-1	-1	0	189	30	6	04/BAR/00018	4	3
22	19	-1	-1	2	189	30	6	04/BAT/00019	4	3
23	20	-1	-1	2	189	30	6	04/DUC/00020	4	3

	K	L	M	N	O	P	Q	R	S	T	U	V
1	7	8	10	11	12	14.1	14.2	14.3	15.11	15.12	15.2	15.21
2			Flight hours			Smoking history			Sport Type I		Sport Type II	
3	Birth date	Pilot speciality	Total	HSG	6 months	Smoker ?	Total smoke	Years quit	Aerobic	Isometric	Quantity	Sport class
4	12-31-63	0	1000	400	160	0	-1	-1	-1	-1	18680,787	4
5	09-20-60	0	1500	)	160	0	-1	-1	-1	-1	10016,252	2
6	05-21-60	0	1750	185	200	0	-1	-1	-1	-1	2221,7538	1
7	09-21-51	0	3800	150	200	0	-1	-1	-1	-1	11484,761	2
8	10/7/56	0	2000	180	80	0	-1	-1	-1	-1	15138,831	4
9	6/5/53	0	3050	80	150	0	-1	-1	-1	-1	2054,6585	1
10	11/11/56	0	2000	1000	135	1	1	-1	-1	-1	12062,769	2
11	02-25-67	-1	-1	-1	-1	1	1	-1	-1	-1	1860,5686	1
12	01-28-59	2	2000	-1	80	1	1	-1	-1	-1	3926,5476	1
13	01-29-59	0	1500	35	35	0	-1	-1	-1	-1	2884,9107	1
14	07-17-49	-1	-1	-1	-1	0	-1	-1	-1	-1	5829,0093	2
15	12-20-63	2	170	-1	-1	0	-1	-1	-1	-1	9123,5078	2
16	12/7/66	-1	-1	-1	-1	0	-1	-1	-1	-1	1049,9261	1
17	2/3/65	0	360	50	40	0	-1	-1	-1	-1	2340,6923	1
18	12-17-54	0	3800	600	180	0	-1	-1	-1	-1	5665,846	2
19	05-15-61	0	1200	540	150	0	-1	-1	-1	-1	3156,923	1
20	05-25-65	0	450	-1	200	0	-1	-1	-1	-1	9483,3414	2
21	4/4/68	-1	-1	-1	-1	0	-1	-1	-1	-1	5813,509	2
22	10/7/63	0	500	170	110	0	-1	-1	-1	-1	49951,331	4
23	2/12/52	0	2820	40	22	0	-1	-1	-1	-1	1811,7692	1

	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	16	17	17.1	18.11	18.12	18.21	18.22	19.1	19.2	20	21.	22.
2				B P seated		B P supine						
3	Size	Weight	Body area	Systolic	Diastolic	Systolic	Diastolic	Cholesterol	HDL cholesterol	Date exam	DPV	DLV
4	183	74	1,95464	120	80	-1	-1	1,81	-1	9/12/88	1,04	5,15
5	173	69	1,821632	140	80	-1	-1	2,38	-1	9/12/88	1,84	5,52
6	175	71	1,859318	120	70	-1	-1	2,03	-1	9/12/88	2,11	5,3
7	181	68	1,87068	135	65	-1	-1	2,82	0,4	06-13-88	1,26	4,98
8	182	79	2,001749	130	70	-1	-1	1,71	-1	9/5/88	1,12	5,31
9	171	81	1,933725	120	65	-1	-1	2,81	-1	9/9/88	1,61	5,38
10	177	60	1,745264	130	80	-1	-1	1,84	-1	9/8/88	1,34	4,88
11	182	64	1,830394	120	70	-1	-1	1,6	-1	8/9/88	1 8	5 2
12	180	63	1,803676	120	70	-1	-1	1,61	-1	08-18-88	1,2	5
13	170	55	1,633413	115	65	-1	-1	1,76	-1	06-27-88	2,3	5,6
14	176	81	1,974555	155	80	-1	-1	2,27	-1	10-18-88	2,1	5,18
15	194	95	2,267541	130	70	-1	-1	2,37	-1	10-17-88	2,73	4,93
16	178	71	1,882373	125	60	-1	-1	1,56	-1	06-25-88	2	5,4
17	165	63	1,693409	125	70	-1	-1	2,32	-1	6/10/88	1,06	4,57
18	174	75	1,895246	125	70	-1	-1	2,16	-1	6/10/88	2,5	5,1
19	181	75	1,950223	145	90	-1	-1	1,74	-1	9/9/88	2,72	5,14
20	169	61	1,69961	120	70	-1	-1	1,35	-1	10-20-88	1,39	4,3
21	181	76	1,961232	150	80	-1	-1	1,8	-1	08-22-88	1,1	5,6
22	179	69	1,867221	120	70	-1	-1	1,9	0,9	10/6/88	2,5	4,65
23	175	75	1,903137	130	80	-1	-1	2,77	0,33	09-28-88	2	5

Figure 7-3 :

	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
1	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.
2			2-D directed, short axis									Long Axis
3	SLV	DST	SST	DPWT	SPWT	Ao	LA	LVPET	LVET	Mitral E-F	Heart rate	Ao
4	3,27	0,66	1	0,65	1,2	-1	3	130	260	138	75	-1
5	3,68	0,7	1,03	0,67	1,12	-1	3,05	119	289	123	58	-1
6	3,95	0,62	0,96	0,7	1,07	-1	3,41	119	309	186	55	-1
7	2,95	0,7	1,17	0,65	1,17	-1	2,96	80	299	100	68	-1
8	3,73	1	1,2	0,96	1,42	-1	3,92	80	330	125	68	-1
9	3,14	0,86	1,21	0,89	1,39	-1	3,99	80	250	191	68	-1
10	3,01	0,77	1,21	0,72	1,3	-1	2,29	89	289	114	90	-1
11	3	1	1,2	0,85	1,4	-1	3	80	299	133	78	-1
12	3,3	0,6	1,2	0,8	1,3	-1	3,2	80	320	147	80	-1
13	3,6	0,9	1,2	0,9	1,3	-1	3,2	89	309	182	50	-1
14	3,28	0,96	1,28	0,97	1,33	-1	3,28	59	239	85	100	-1
15	3,32	0,9	1,1	0,9	1,3	-1	3,09	70	359	96	46	-1
16	3,4	0,8	1,2	0,8	1,2	-1	2,8	70	280	118	71	-1
17	3,2	0,6	1	0,7	1,1	-1	3	59	299	112	68	-1
18	3,3	0,8	1,2	0,7	1,1	-1	3,8	89	309	85	80	-1
19	3,16	0,75	1,13	0,78	1,23	-1	3,23	89	289	73	71	-1
20	2,51	0,72	1,16	0,81	1,3	-1	3,1	80	280	128	83	-1
21	3,6	0,8	1,3	0,8	1,3	-1	3,5	70	250	-1	68	-1
22	2,96	0,8	1,1	0,92	1,38	-1	2,34	110	299	118	47	-1
23	3,22	0,66	1,3	0,77	1,4	-1	3,27	70	320	121	56	-1

	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE
1	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.
2	Parasternal	Short Axis, below mitral valve					Apical Four Chamber View				
3	LA	DRV	DLV	SLV	DST	SST	DPWT	SPWT	RV max	RV area	Peak velocity
4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
6	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
7	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
8	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
11	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
15	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
16	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
18	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
19	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
21	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

	BF	BG	BH	BI	BJ	BK	BL	BM	BN
1	46.	47.	48.	50.	51.	52.	53.	55.	56.
2	AORTIC FLOW			PULMONIC FLOW			Mitral Valve		
3	Pre eject time	Ejection time	Acceler time	Peak velocity	Pre eject time	Ejection time	Acceler time	Peak velocity E	Peak velocity A
4	-1	-1	-1	-1	-1	-1	-1	-1	-1
5	-1	-1	-1	-1	-1	-1	-1	-1	-1
6	-1	-1	-1	-1	-1	-1	-1	-1	-1
7	-1	-1	-1	-1	-1	-1	-1	-1	-1
8	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	-1	-1	-1	-1	-1	-1	-1	-1	-1
10	-1	-1	-1	-1	-1	-1	-1	-1	-1
11	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	-1	-1	-1	-1	-1	-1	-1	-1	-1
13	-1	-1	-1	-1	-1	-1	-1	-1	-1
14	-1	-1	-1	-1	-1	-1	-1	-1	-1
15	-1	-1	-1	-1	-1	-1	-1	-1	-1
16	-1	-1	-1	-1	-1	-1	-1	-1	-1
17	-1	-1	-1	-1	-1	-1	-1	-1	-1
18	-1	-1	-1	-1	-1	-1	-1	-1	-1
19	-1	-1	-1	-1	-1	-1	-1	-1	-1
20	-1	-1	-1	-1	-1	-1	-1	-1	-1
21	-1	-1	-1	-1	-1	-1	-1	-1	-1
22	-1	-1	-1	-1	-1	-1	-1	-1	-1
23	-1	-1	-1	-1	-1	-1	-1	-1	-1

Figure 7-3 (continue) :

	BO	BP	BQ
1	58.	59.	61
2	Tricuspid Valve		
3	Peak velocity E	Peak velocity A	Other Echo
4	-1	-1	-1
5	-1	-1	-1
6	-1	-1	-1
7	-1	-1	-1
8	-1	-1	-1
9	-1	-1	-1
10	-1	-1	-1
11	-1	-1	-1
12	-1	-1	-1
13	-1	-1	-1
14	-1	-1	-1
15	-1	-1	-1
16	-1	-1	-1
17	-1	-1	-1
18	-1	-1	-1
19	-1	-1	-1
20	-1	-1	-1
21	-1	-1	-1
22	-1	-1	-1
23	-1	-1	-1

Figure 7-3 (end) :

V.6 - Backup on floppy disks :

This option can be used to transfer the file to one or several floppy disks. The software starts by cleaning the file if necessary (destroy suppressed cards) and transfer all entered cards to the floppy disks. A new floppy disk has to be placed in the unit if the previous one is full. The file names on floppy disks have the name "PILOTS.DA0" for the first floppy disk, "PILOTS.DA1" for the second, "etc..".

Once the file on hard disk is created, use this option to prepare floppy disks in order to send them to Brooks USAFB for processing.

This option can be used to create a personal backup of the file PILOTS.DAT in order to be able to retrieve your files in case your hard disk fails. Regular backups are advised in order to minimize problems which occurs if the hard disk crashes. This backup can also be made through the "BACKUP" command of the IBM DOS. If you use the PILOTS option to backup your file, this DOS command will be used to retrieve your data file if you have problems :

COPY A:PILOTS.DA0+B:PILOTS.DA1+A:PILOTS.DA2(...) C:\PILOTS\PILOTS.DAT

A backup of the PILOTS repertory with the DOS command will be more efficient and certainly more simple to use for the backup.

VI . COMMENTS

VI.1 - Changing a card :

The software keeps in memory the last modified or created card even it has not been written in the file. When calling a function requiring a writting or reading of the file with a card in memory which has not been backed up, a window appears wich requires confirmation of the non validation of changes. If you do not confirm, the change is lost otherwise it is written and validated in the file.

A modified or entered card is therefore not lost when the user has forgotten to validate the card by pressing the F2 key !

VI.2 - Recovery of a deleted card :

What happens if the user has deleted a card ?

A flag is simply positioned in the card saying that it has been deleted. In case of error, you retrieve the file previously entered by using option "Correct a card" and selecting the empty card having the same number. The flag will be repositioned as full if you validate by the F2 key. Deleted cards will appear under the name "Empty card".

The deleted card will be crushed in the file (physically destroyed) by selecting option "Input of a new card" and validating the new card. This new card takes in the file the place of the deleted card. The termination of the program also crushes all deleted cards in order to minimize file size. Entered cards are then translated in order to fill all empty spaces. The various card numbers are then modified !

VI.3 - Use of the mouse for card acquisition :

The mouse can be used to select the variable to be modified by placing the pointer on the wanted variable. A click on one of the two buttons of the mouse will shift the pointer to the next variable.

VI.4 - Notes on the software :

The software was written in C language and in assembler from the "TURBO C" compiler of Borland International and from a library written by us in assembler for IBM PC in order to :

- manage pop-up menus,
- manage mouse and screen outputs,
- enter character strings with more powerful functions than basic procedures,
- select an item in any list,
- manage direct access files.

VI.5 - Translation of messages :

"TRADUIT" program is used to translate into the language of your choice all messages or acquisition screens of PILOTS software. This program is automatically initiated by INSTALL but it can also be run by you in order for instance to modify a message which does not seam correct to you. Insert software floppy disk and type "A:TRADUIT (Enter)".

TRADUIT must be able to find the software floppy disk in reader A: in order to start. This floppy disk contains message files in English and French in order to help you during your translation.

You will have to translate :

- All PILOTS messages according to syntax and authorized maximum length. The character "@" in a message indicates variable output. You will have to place in the translated message the same number of outputs as contained in the starting message !!
For example, the TRADUIT message : "Limits for this variable are @ < X < @" correspond to a screen output in PILOTS of : "Limits for this variable are 0.00 < X < 1.00".

- The various basic screens of the acquisition card. All you have to do is translate messages of the basic screen, the tables being themselves defined, they can not be modified. You can move in the screens using the arrows keys or the mouse.

- The various help screens called by function "F1 = Help".

If you only want to change something in one of these three types of messages, you are not obliged to retranslate all the rest. All you have to do is select the type to be modified.

To help you, TRADUIT will display the translation in French and English for each message.

The complete translation certainly requires adjustments. It is possible that your own messages extend on one variable or exit a window. In this case, you can have "strange things" on your screen. It is therefore advised to test all functions of this software before checking if your translation is correct.

To copy your translation onto another machine, all you have to do is copy files "C:\PILOTS\PILOTS.LN3", "C:\PILOTS\PILOTS.ECR" and "C:\PILOTS\PILOTS.HLP" on the new machine thru a floppy disk after placing this software into this machine. You can thus exchange your translation files if necessary.

If they are any problems with this "capricious" program, you can directly contact Mr PIEDECOCQ in CERMA/LCBA Bretigny FRANCE or send me your 3 translated files on a floppy disk for adjustment with very precise indications of the type of problem you encountered.

Appendices

VII.2 - Sports list :

0 : Indeterminate !
1 : Reset all sports !
2 : Aerobics
3 : Archery
4 : Badminton
5 : Basketball
6 : Bowling
7 : Boxing : in ring
8 : Boxing : sparring
9 : Canoeing : competition
10 : Canoeing : leisure
11 : Circuit-training
12 : Climbing hills with 20Kg
13 : Climbing hills with 10Kg
14 : Climbing hills with 5Kg
15 : Climbing hills with no load
16 : Cricket : Batting
17 : Cricket : Bowling
18 : Croquet
19 : Cycling : Competition
20 : Cycling : Leisure 15 km/h
21 : Cycling : Leisure 8 km/h
22 : Field hockey
23 : Football, American
24 : Golf
25 : Gymnastic
26 : Horse riding : courses, galoper
27 : Horse riding : entretien d'un
28 : Horse riding : Marche
29 : Horse riding : Trot
30 : Ice hockey
31 : Judo
32 : Marching, rapid
33 : Musculation : Circuit of (Men)
34 : Musculation : Circuit of (Women)
35 : Running : Cross-country
36 : Running : on the level, 5'30 per mile
37 : Running : on the level, 6' per mile
38 : Running : on the level, 7' per mile
39 : Running : on the level, 8' per mile
40 : Running : on the level, 9' per mile
41 : Running : on the level, 11'30 per mile
42 : Scuba diving : Moderately active
43 : Scuba diving : Very active
44 : Skiing : Hard snow, On hill, maximum speed
45 : Skiing : Hard snow, On the flat, walking
46 : Skiing : Hard snow, On the flat, moderate speed
47 : Skiing : Powdered snow, Leisure (Woman)
48 : Skiing : Powdered snow, Leisure (Men)
49 : Snow shoeing : Powdered snow
50 : Soccer, European Football
51 : Squash
52 : Swimming : Breast stroke
53 : Swimming : Crawl leisure
54 : Swimming : Crawl fast
55 : Swimming : Backstroke
56 : Swimming : Sidestroke
57 : Swimming : Treading normal
58 : Swimming : Treading rapide
59 : Table tennis
60 : Tennis
61 : Volleyball
62 : Walking, normal pace, plowed field
63 : Walking, normal pace, fields & hillsides
64 : Walking, normal pace, Asphalt road
65 : Walking, normal pace, Grass track
66 : Weight training

VII.5 - Variable validity limits :

	VARIABLE	Minimum	Patholog. minimum	Patholog. maximum	Maximum
09	Flying history : Years	1940			2040
09	Flying history : Hours	0			30000
10	Flying history : Total	0			30000
11	Flight hours : on HSG aircraft	0			5000
12	Flight hours : in past six months	0			2000
14	Tabac : Packs/Day	0			10
14	Tabac : #Years	0			50
16	Size	150			200
17	Weight	45			120
18	Blood pressure : systolic	90	110	150	200
18	Blood pressure : diastolic	40	60	90	120
19	Cholesterol : total	100	170	220	350
19	Cholesterol : HDL	20	30	70	130
21	RV internal dimension / diastole	0.5	0.7	2.6	3.5
22	LV internal dimension / diastole	2.8	3.5	5.7	8
23	LV internal dimension / systole	2	2.5	4.5	8
24	Septal thickness / diastole	0.4	0.6	1.1	3
25	Septal thickness / systole	0.7	0.9	1.6	3.5
26	Posterior wall thickness / diastole	0.4	0.6	1.1	3
27	Posterior wall thickness / systole	0.7	0.9	1.6	3
28	Aortic dimension	1.5	2.1	4.2	6
29	Left atrial dimension	1.5	1.9	4	7
30	LV pre-ejection time	40	60	110	151
31	LV ejection time	160	220	360	450
32	Mitral EF slope	30	60	220	300
33	Heart rate	40	50	90	150
34	Aortic dimension	1.7	2.0	4	6
35	Left atrial dimension	1.5	1.9	4	7
36	RV internal dimension / diastole	0.5	0.7	2.6	5
37	LV internal dimension / diastole	2.8	3.5	5.7	9.95
38	LV internal dimension / systole	2	2.5	4.5	8
39	Septal thickness / diastole	0.4	0.6	1.1	3
40	Septal thickness / systole	0.7	0.9	1.6	3.5
41	Posterior wall thickness / diastole	0.4	0.6	1.1	3
42	Posterior wall thickne / systole	0.7	0.9	1.6	3
43	RV maximum intern. dim. / diastole	1.5	2.1	2.6	5
44	RV area / diastole	8	13.4	15.9	36.3
45	Aortic : Peak velocity	0.2	0.9	1.7	6
46	Aortic : LV pre-ejection time	40	55	110	130
47	Aortic : LV ejection time	240	270	330	360
48	Aortic : Acceleration time	50	70	110	140
50	Pulmonic : Peak velocity	0.3	0.6	0.9	6
51	Pulmonic : RV pre-ejection time	40	60	110	130
52	Pulmonic : RV ejection time	220	280	360	450
53	Pulmonic : Acceleration time	60	120	160	200
55	Mitral : Peak velocity E	0.3	0.4	1.3	6
56	Mitral : Peak velocity A	0.3	04	1.3	6
58	Tricuspid : Peak velocity E	0.2	0.3	0.7	6
59	Tricuspid : Peak velocity A	0.2	0.3	0.7	6

VII.6 - Card structure :

The internal structure of the PILOTS.DAT file is given here. You will find each variable name with its number in the working sheet, the size and the type of this element and the offset in bytes from the start of the card. The 3 exclusion criteria variables are coded bit to bit in a byte, which means that each of the 8 bits of this variable represent the state of one of the 8 exclusion criteria.

Number	Variable name	Type	Size	Offset
	plein	Byte	1	0
4	ident_pays	Byte	1	1
6	nationalite	Byte	1	2
5	study_pays	Byte	1	3
1.1	cross_study	Byte	1	4
1.2	long_study	Byte	1	5
1.3	retro_study	Byte	1	6
1.4	echo_2d	Byte	1	7
1.5	m_mode	Byte	1	8
3.1	criteres_both	Byte	1	9
3.2	criteres_cross	Byte	1	10
3.3	criteres_long	Byte	1	11
4	ident_letter	String[9]	9	12
91	other_param	String[5]	5	21
11.2	hsg_combat	Byte	1	26
11.3	hsg_air_air	Byte	1	27
11.4	hsg_air_ground	Byte	1	28
12.2	six_combat	Byte	1	29
12.3	six_air_air	Byte	1	30
12.4	six_air_ground	Byte	1	31
2	reason_echo	Byte	1	32
49	ao_insuffisence	Byte	1	33
54	pulm_insuffisence	Byte	1	34
14.1	fumeur	Byte	1	35
14.5	annees_sans_tabac	Byte	1	36
8	specialite	Byte	1	37
15.4	classe_sport	Byte	1	38
57	mitral_regurg	Byte	1	39
60	tri_regurg	Byte	1	40
15.1	sport_aerobic	Byte	1	41
15.2	sport_isometric	Byte	1	42
61	other_echo	Byte	1	43
62	mitral_stenotic	Byte	1	44
63	mitral_thickened_al	Byte	1	45
64	mitral_redundant_al	Byte	1	46
65	mitral_prolapse_al	Byte	1	47
66	mitral_flail_al	Byte	1	48
67	mitral_fluttering_al	Byte	1	49

Number	Variable name	Type	Size	Offset
68	mitral_thickened_pl	Byte	1	50
69	mitral_redundant_pl	Byte	1	51
70	mitral_prolapse_pl	Byte	1	52
71	mitral_flail_pl	Byte	1	53
72	mitral_fluttering_pl	Byte	1	54
74	tri_thickened	Byte	1	55
75	tri_redundant	Byte	1	56
76	tri_prolapse	Byte	1	57
77	tri_flail	Byte	1	58
73	tri_stenotic	Byte	1	59
78	pulm_stenotic	Byte	1	60
79	aortic_bicuspid	Byte	1	61
80	aortic_thickened	Byte	1	62
81	aortic_stenotic	Byte	1	63
82	aortic_calcified	Byte	1	64
83	walls_motion	Byte	1	65
85	walls_assy	Byte	1	66
86	myxoma	Byte	1	67
87	focal_hyper	Byte	1	68
88	septal_paradox	Byte	1	69
89	asd	Byte	1	70
90	vsd	Byte	1	71
91	thrombus	Byte	1	72
83-9	walls_segments	Byte[9]	9	73
7	naissance	Date	4	82
13	dernier_vol	Date	4	86
20	examen	Date	4	90
9.1	history[1]	Hist	7	94
9.2	history[2]	Hist	7	101
9.3	history[3]	Hist	7	108
9.4	history[4]	Hist	7	115
9.5	history[5]	Hist	7	122
9.6	history[6]	Hist	7	129
9.7	history[7]	Hist	7	136
9.8	history[8]	Hist	7	143
9.9	history[9]	Hist	7	150
9.10	history[10]	Hist	7	157
10	flight_hours	Integer	2	164
11.1	flight_hours_hsg	Integer	2	166
12.1	flight_six_months	Integer	2	168
16	taille	Integer	2	170
17.1	poids	Integer	2	172
18.1	systole_bp_seated	Integer	2	174

Number	Variable name	Type	Size	Offset
18.2	systole_bp_supine	Integer	2	176
18.3	diastole_bp_seated	Integer	2	178
18.4	diastole_bp_supine	Integer	2	180
33	freq_card	Integer	2	182
32	efsi	Integer	2	184
48	ao_acc_time	Integer	2	186
46	ao_lvpet	Integer	2	188
47	ao_lvet	Integer	2	190
51	pulm_rvpet	Integer	2	192
52	pulm_rvet	Integer	2	194
53	pulm_acc_time	Integer	2	196
30	lvpet	Integer	2	198
31	lvet	Integer	2	200
19.1	cholesterol	Integer	2	202
19.2	hdl_cholesterol	Integer	2	204
15.3	sport	Real	8	206
17.2	surface_corps	Real	8	214
21	rv_short_2d	Real	8	222
22	dlv	Real	8	230
23	slv	Real	8	238
24	dst	Real	8	246
25	sst	Real	8	254
26	dpwt	Real	8	262
27	spwt	Real	8	270
28	ao_short_2d	Real	8	278
29	la	Real	8	286
34	ao_long	Real	8	294
35	la_long	Real	8	302
36	rv_short	Real	8	310
39	dst_short	Real	8	318
40	sst_short	Real	8	326
41	dpwt_short	Real	8	334
42	spwt_short	Real	8	342
37	dlv_short	Real	8	350
38	slv_short	Real	8	358
43	rv_max	Real	8	366
44	rv_area	Real	8	374
45	ao_velocity	Real	8	382
55	mitral_velocity_e	Real	8	390
56	mitral_velocity_a	Real	8	398
50	pulm_velocity	Real	8	406
58	tri_velocity_e	Real	8	414
59	tri_velocity_a	Real	8	422

Number	Variable name	Type	Size	Offset
92	fs	Real	8	430
93	ef	Real	8	438
94	sv	Real	8	446
95	mean_vcf	Real	8	454
96	ci	Real	8	462
97	fwt	Real	8	470
98	h_r	Real	8	478
99	lvm	Real	8	486
100	sws	Real	8	494
101	rv_pet_et	Real	8	502
102	rv_pet_at	Real	8	510
103	rv_at_et	Real	8	518
104	lv_pet_et	Real	8	526
105	lv_pet_at	Real	8	534
106	lv_at_et	Real	8	542
14.4	tabac_an	Real	8	550
15.3	doses_minutes	Integer[67]	134	558
15.3	doses_sport	Byte[67][2]	134	692
14.3	annees_tabac	Byte[4]	4	826
14.2	paquets_jour	Real[4]	32	830
				862

VII.7 - Correspondence between numbers and variables :

Fiche	Card number
1	Subject cross : all var.
1.1	Cross-sectional
1.2	Longitudinal
1.3	Retrospective
1.4	2-D echo
1.5	M-Mode
2	Reason for study
3	Exclusion criteria : 3 int.
3.1	Pilot ?
3.2	On CV drugs ?
3.3	Free from diagnose ?
3.4	Male ?
3.5	Echo acceptable ?
3.6	Age >17 & <56 ?
3.7	Suspected card. disease ?
3.8	Total flight hrs known ?
3.9	Mixed fighter/transport ?
3.10	Elligible for flying ?
3.11	Essential echo param. ?
3.12	Type I exercise available ?
3.13	Flown during past 36 mths ?
3.14	Received his pilot wing ?
3.15	Type II exercise avail.?
3.16	Include M,2D,color,dop.?
4	Identification number
5	Nation where study ...
6	Nationality
7	Birth date
7.1	Birth date : day
7.2	Birth date : month
7.3	Birth date : year
8	Pilot specialty
9	Military flying hist.:all
9.1	History : line 1
9.2	History : line 2
9.3	History : line 3
9.4	History : line 4
9.5	History : line 5
9.6	History : line 6
9.7	History : line 7
9.8	History : line 8
9.9	History : line 9
9.10	History : line 10
10	Total flight hours
11	Flying hours on HSG : all var.
11.1	Hours
11.2	% Air combat
11.3	% Air intercept
11.4	% Air to ground
12	Last 6 mths flying hrs :all
12.1	Hours
12.2	% Air combat
12.3	% Air intercept
12.4	% Air to ground
13	Date of last flight
13.1	Last flight : day
13.2	Last flight : month
13.3	Last flight : year
14	Tabac : all variables
14.1	Have you smoked ?
14.2	Total pack years
14.3	Years since quitting
15	Sport : All variables
15.11	Sport Type I aerobic
15.12	Sport Type I isometric
15.20	Sport Type II Kj/week
15.21	Sport Type II class
15.22	Sport Type II : doses/sports
16	Size
17	Weight
17.1	Body area
18	Blood pressure : all var.
18.11	Systolic Seated
18.12	Diastolic Seated
18.21	Systolic Supine
18.22	Diastolic Supine
19	Cholesterol : all var.
19.1	Cholesterol
19.2	HDL cholesterol
20	Date of echo
20.1	Date echo : day
20.2	Date echo : month
20.3	Date echo : year
21	to 107 : see work-sheet !

VII.8 - IBM PC character set code :

000	NUL	064	@	128	Ç	192	└
001	SOH	065	A	129	ü	193	┴
002	STX	066	B	130	é	194	┬
003	ETX	067	C	131	â	195	├
004	EOT	068	D	132	ä	196	─
005	ENQ	069	E	133	à	197	┼
006	ACK	070	F	134	å	198	╞
007	BEL	071	G	135	ç	199	╟
008	BS	072	H	136	ê	200	╚
009	TAB	073	I	137	ë	201	╔
010	LF	074	J	138	è	202	╩
011	VT	075	K	139	ï	203	╦
012	FF	076	L	140	î	204	╠
013	CR	077	M	141	ì	205	═
014	SO	078	N	142	Ä	206	╬
015	SI	079	O	143	Å	207	╧
016	DLE	080	P	144	É	208	╨
017	DC1	081	Q	145	æ	209	╤
018	DC2	082	R	146	Æ	210	╥
019	DC3	083	S	147	ô	211	╙
020	DC4	084	T	148	ö	212	╘
021	NAK	085	U	149	ò	213	╒
022	SYN	086	V	150	û	214	╓
023	ETB	087	W	151	ù	215	╫
024	CAN	088	X	152	ÿ	216	╪
025	EM	089	Y	153	Ö	217	┘
026	SUB	090	Z	154	Ü	218	┌
027	ESC	091	[	155	¢	219	█
028	FS	092	\	156	£	220	▄
029	GS	093	]	157	¥	221	▌
030	RS	094	^	158	₧	222	▐
031	US	095	_	159	ƒ	223	▀
032	SPA	096	`	160	á	224	α
033	!	097	a	161	í	225	ß
034	"	098	b	162	ó	226	Γ
035	#	099	c	163	ú	227	π
036	$	100	d	164	ñ	228	Σ
037	%	101	e	165	Ñ	229	σ
038	&	102	f	166	ª	230	µ
039	'	103	g	167	º	231	τ
040	(	104	h	168	¿	232	Φ
041	)	105	i	169	⌐	233	Θ
042	*	106	j	170	¬	234	Ω
043	+	107	k	171	½	235	δ
044	,	108	l	172	¼	236	∞
045	-	109	m	173	¡	237	ø
046	.	110	n	174	«	238	∈
047	/	111	o	175	»	239	∩
048	0	112	p	176	▒	240	≡
049	1	113	q	177	▓	241	±
050	2	114	r	178	│	242	≥
051	3	115	s	179	┤	243	≤
052	4	116	t	180	╡	244	⌠
053	5	117	u	181	╢	245	⌡
054	6	118	v	182	╖	246	÷
055	7	119	w	183	╕	247	≈
056	8	120	x	184	╣	248	°
057	9	121	y	185	║	249	∙
058	:	122	z	186	╗	250	·
059	;	123	{	187	╝	251	√
060	<	124	¦	188	╜	252	ⁿ
061	=	125	}	189	╛	253	²
062	>	126	~	200	╖	254	■
063	?	127	DEL	201	╔	255	DEL

Glossary

VIII. GLOSSARY : Definition of a few technical terms :

- ASCII file : File containing only characters. digital variables are coded by a row of characters. Since one character occupies one byte, these files use up much space on a disk. This principle was therefore rejected to record cards. But since this language is very simple, most commercial softwares can read it.

- Attribute : The attribute number of a character gives the display color to the screen. For IBM PC, attributes can have 64 values (Combination of 8 backgrounds and 8 character colors).

- Bit : Basic unit to code any number in a computer. This number is coded in base 2 and a bit can only have values 0 or 1.

- Byte, Kb : A byte is a group of 8 bits. It is used to code an integer value, maximum values of this integer will be -128 to +127. A Kb (kilobytes) represents 1024 bytes. A Mb (Mega bytes) represents 1024 Kb. These units are often used to give the size of a memory, of a software or of a disk.

- Card : Recording of various variables making up the pilot's card.

- Disk unit : File backup unit which can be a floppy disk or a hard disk, etc... Different units under IBM DOS are called A: and B: for the first two floppy disk units. The various hard disks start with unit C: and so on.

- File name : A DOS file name is used to retrieve files written on back up unit. This name consists of eight letters followed by a colon and three more letters. Example : "PILOTS.DAT"

- IBM DOS : The operating system of your IBM for screen, keyboard, disk unit management and for initiation of certains commands.

- Memory : The computer memory temporarily stores the machine code of your software as well as the various data requires for its operation.

- Menu bar : The menu bar is a line on the screen which displays certain characteristics. The bar of a menu is the name of this menu which appears on the menu bar displayed on line 1 of the screen.

- Option : Various possibilities offered by a menu.

- Pop-up menus : device to select an order to be carried out by software. A window appears on the screen to allow choice of the order and disappears once this choice has been made.

- Printer : Outputs can be printed on most printers compatible with the basic IBM PC character set. Post-Script, Apple Laserwriter printers, for example, are not compatible because of their own programmation language.

- Repertory : A hard disk under DOS can be divided into different repertories to group various files under the same name. A repertory could be compared to a drawer where a number of items are stored. These repertories are organized in a tree-shaped structure. Each drawer can contain one or several other drawers which can also contain..., etc... The initial drawer called principal repertory is also called "C:\" if the unit is "C:". The name of the file : "C:\PILOTS\DATA\TEST\PILOTS.DAT" indicates that the file is in unit C, in repertory TEST contained in repertory DATA itself contained in repertory PILOTS.

- Serial, parallel port : There are 2 communication systems on an IBM PC type computer : serial connections for connection of a mouse or printer (slow connection). Parallel connection for easy connection with a printer (rapid connection).

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The Report considers the protocol for a planned cross-sectional and a longitudinal study on Echocardiography in NATO Aircrew. It gives an overview of the procedures manual, technical manual, the echo data sheet, the sotware program and the quality control manual. The report includes a mutlinational protocol for the performance and reporting of echocardiograms.

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